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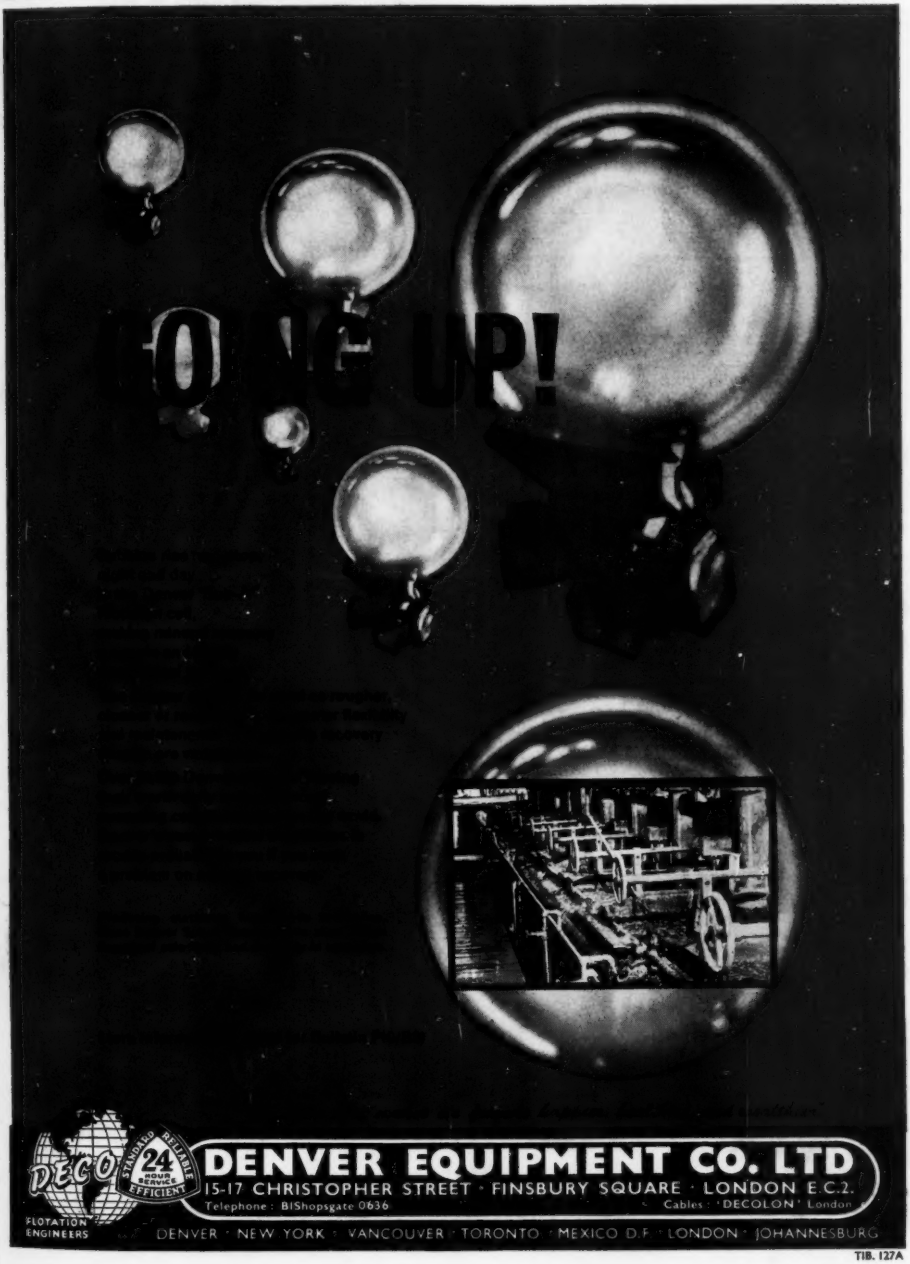
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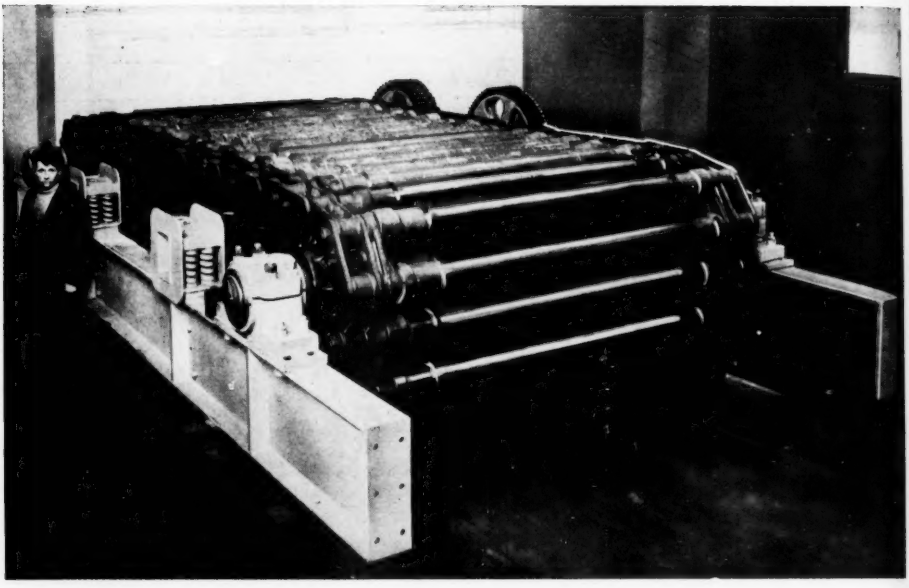

Ross Drop-Bar Feeder for Kneeshaw Lupton & Co. Ltd., Llanddulas Quarries, North Wales

Photograph shows a No. 10 Patent Ross Drop-Bar Feeder on shop assembly before despatch to Kneeshaw Lupton & Co. Ltd., for feeding a 60″ x 42″ jaw crusher at their Llanddulas Quarries. The photograph illustrates the very heavy construction of the apron, in this case 7″ dia. steel bars at 10″ centres, and the heavy shock absorbing coil springs which support the apron.

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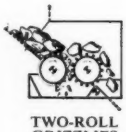

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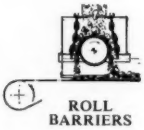

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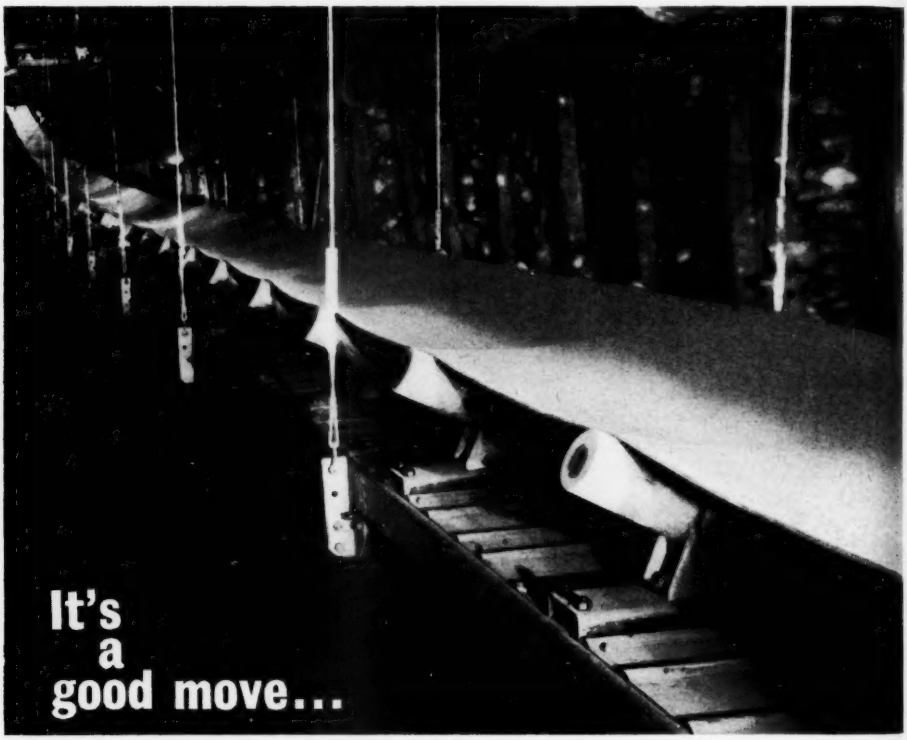
Photograph by permission of the National Coal Board. Trunk conveyor, 1100 yards between centres, at Haig Colliery, Cumberland. 42 inches wide, 4 ply CN80 (nylon weft) belt by Barrow Hepburn & Gale, Mitcham.



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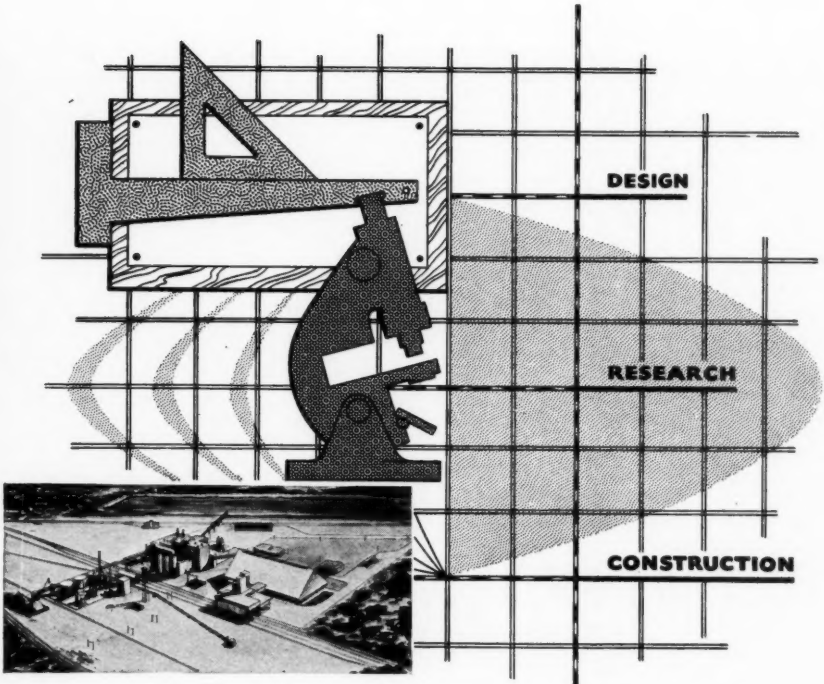

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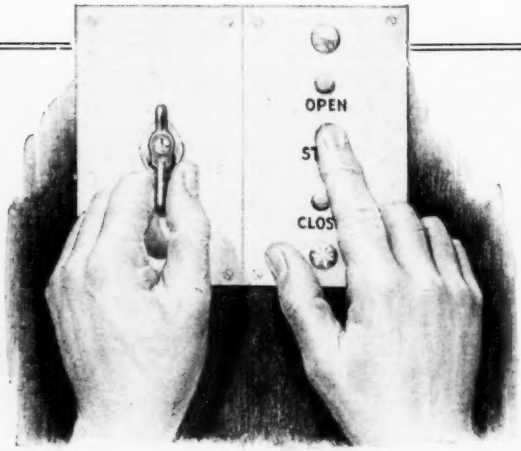

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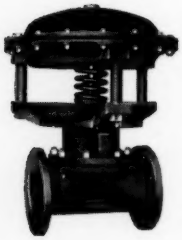

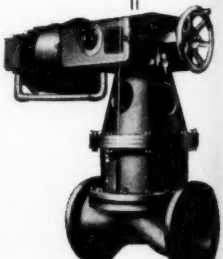

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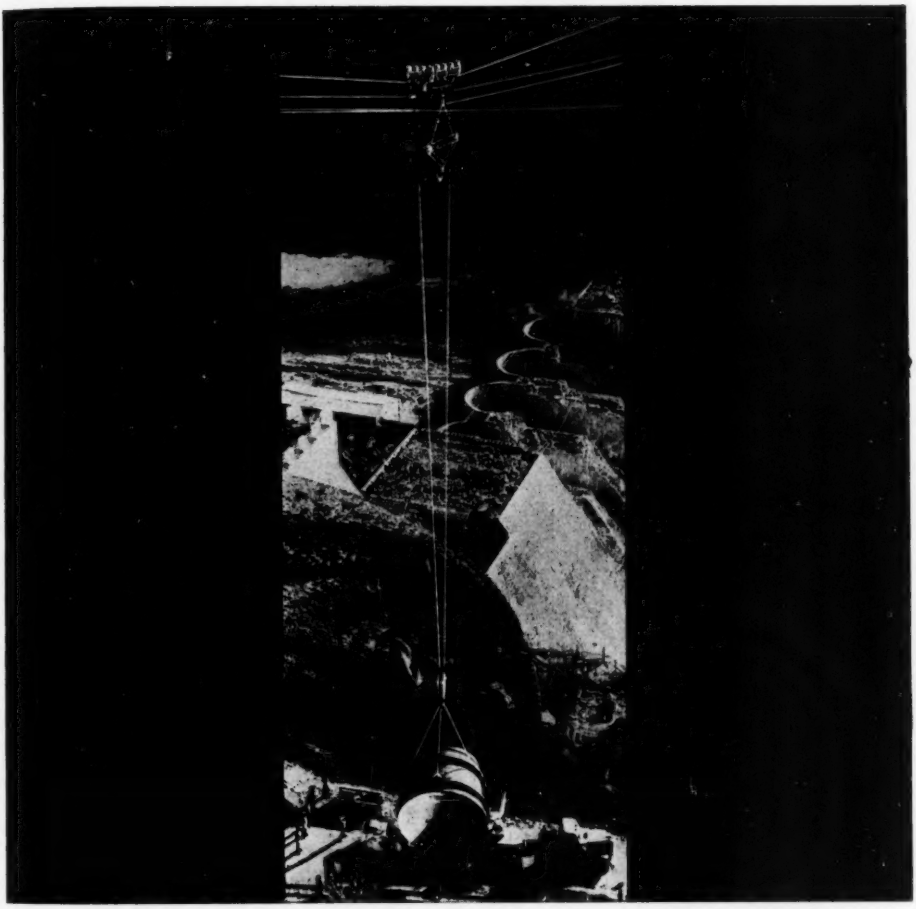

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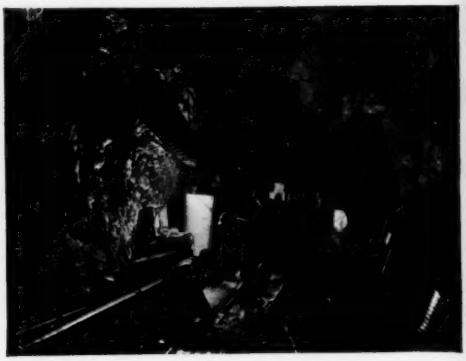

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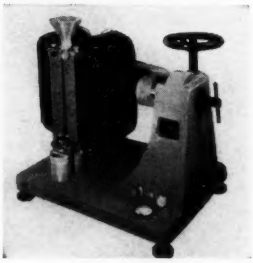

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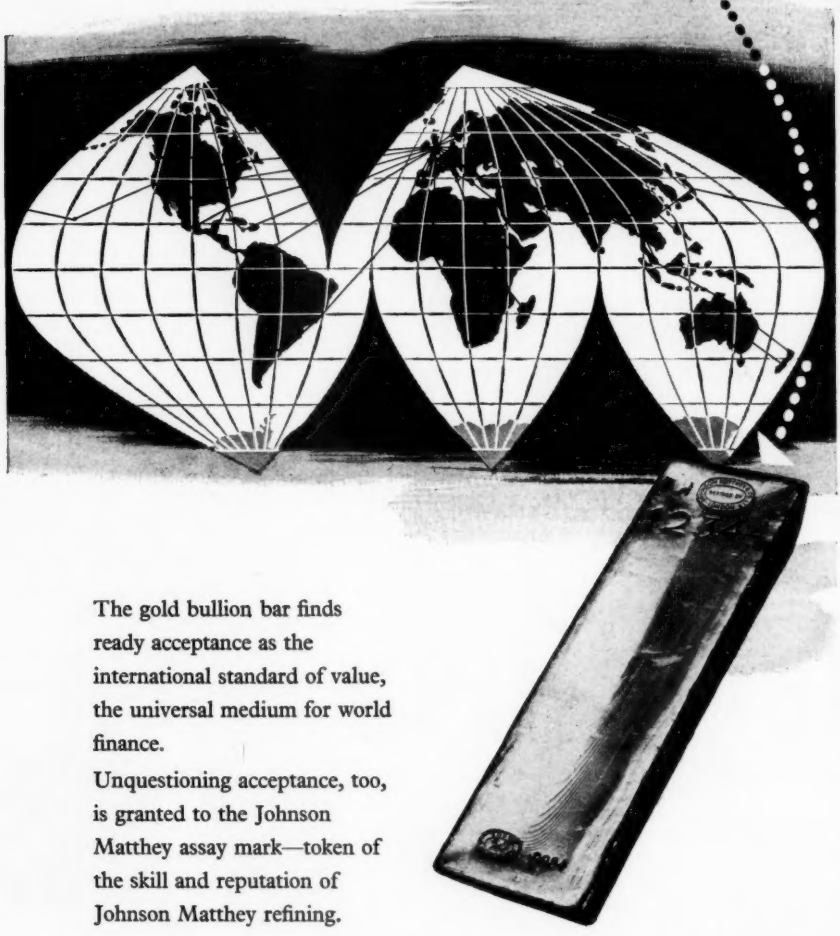

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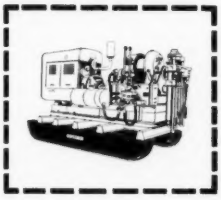

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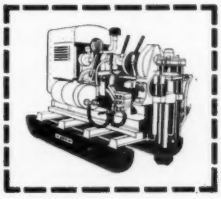

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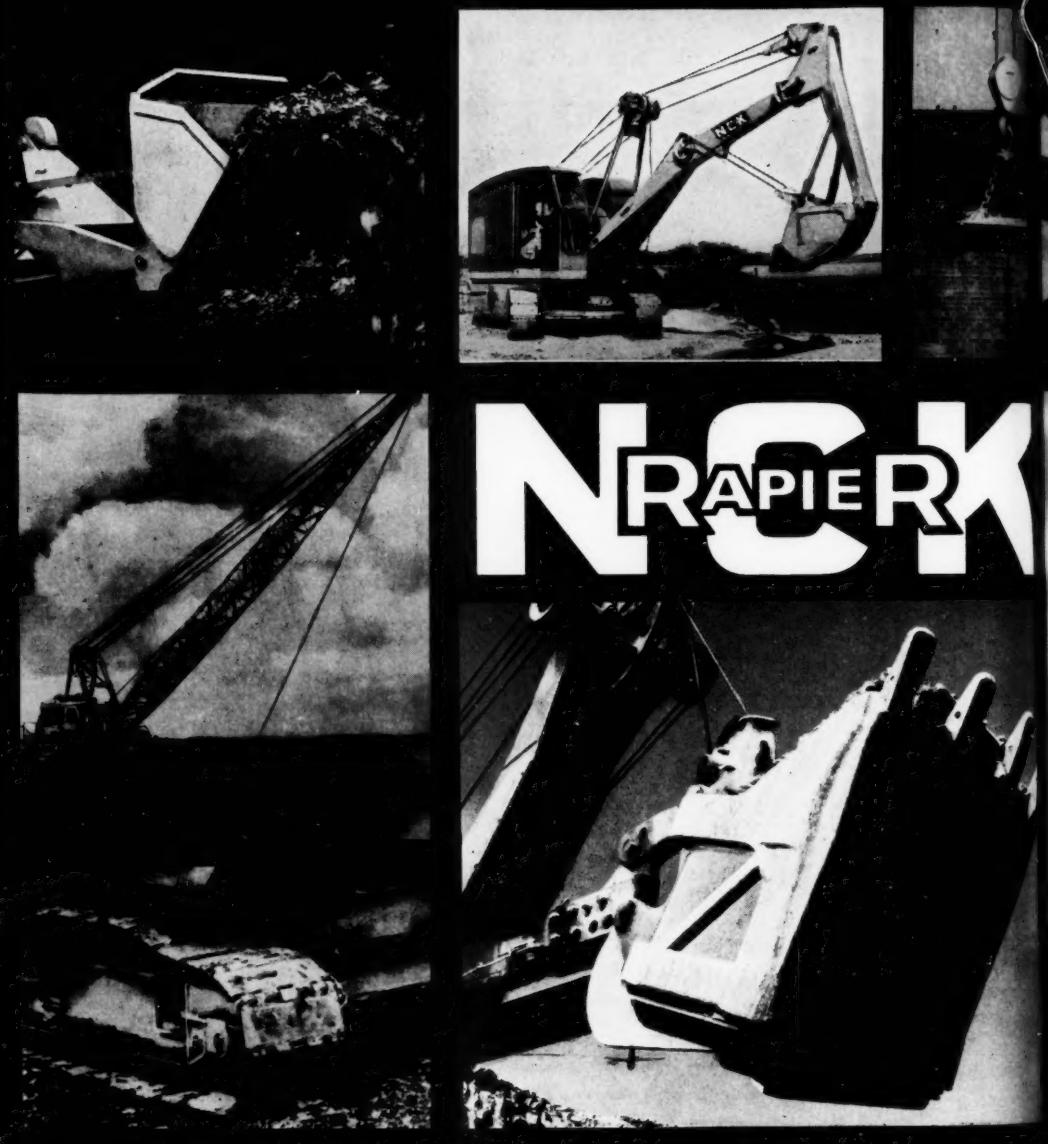

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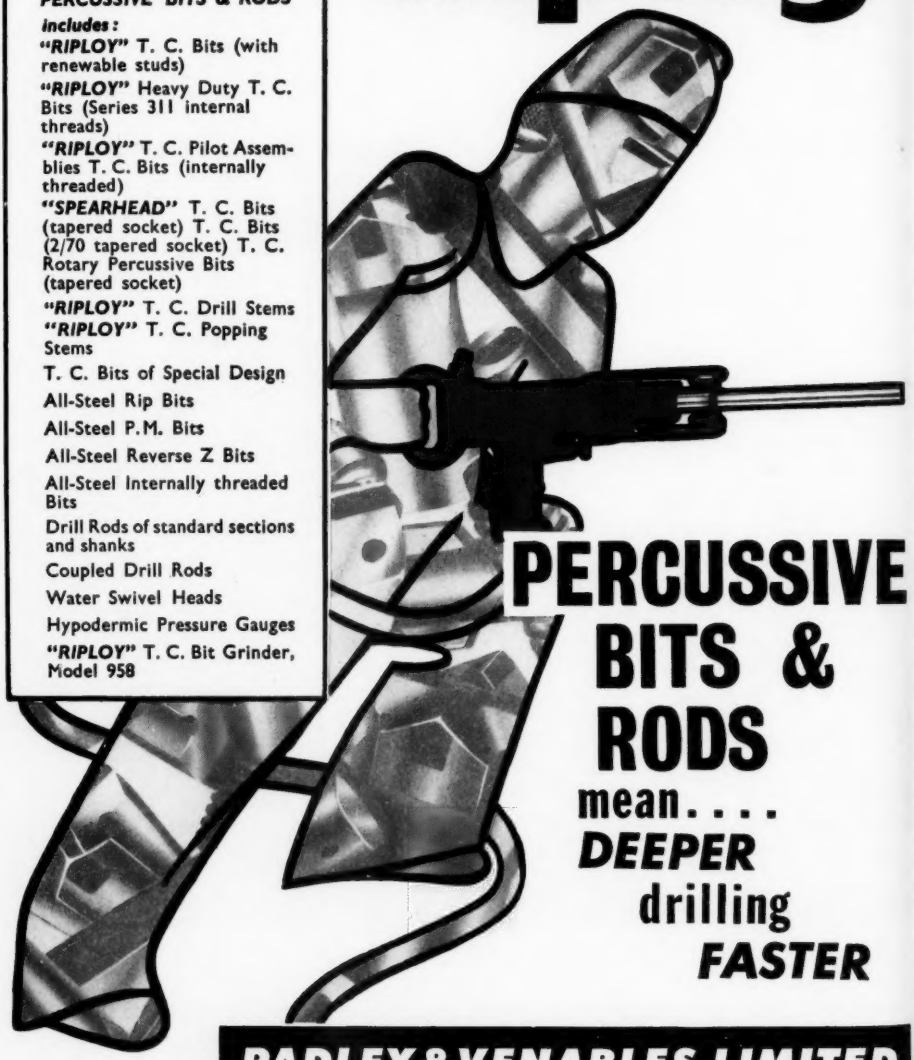

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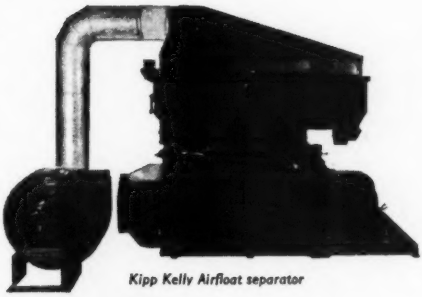

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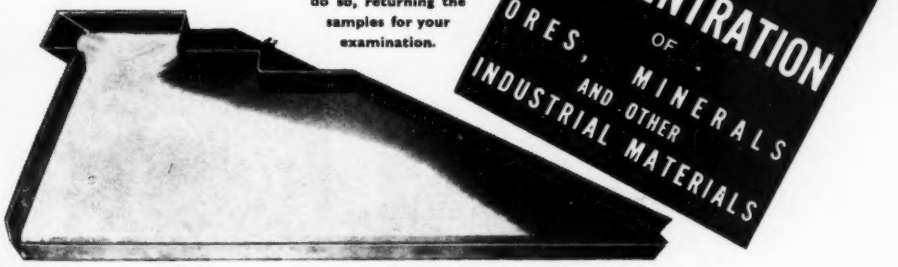

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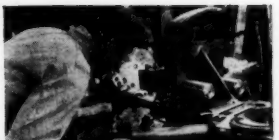

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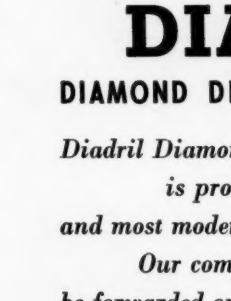

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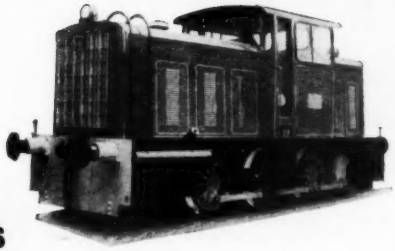

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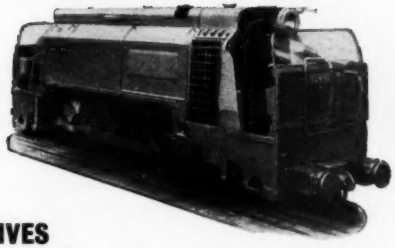

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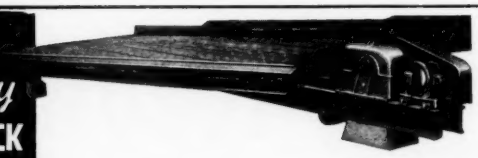

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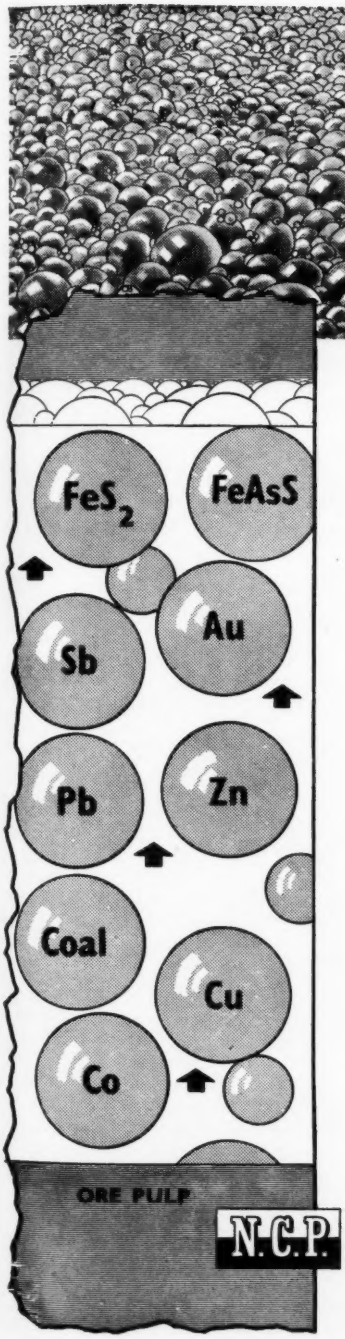

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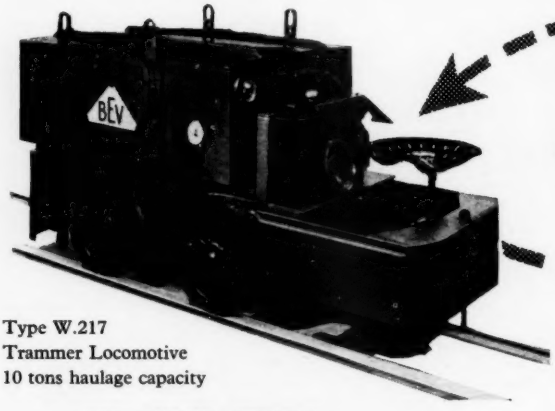

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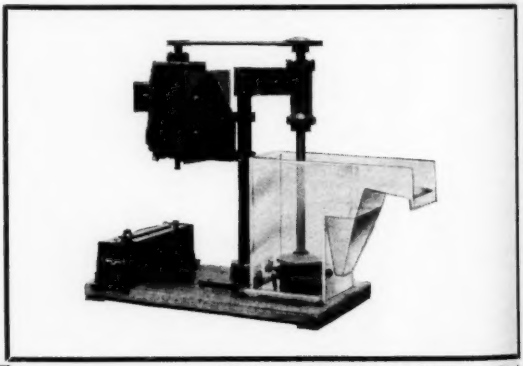

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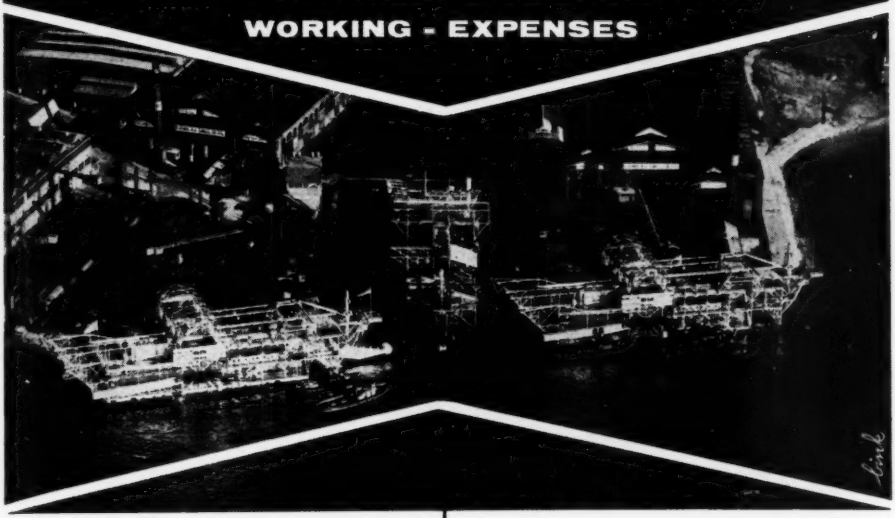

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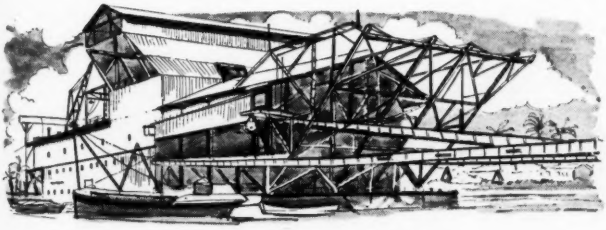

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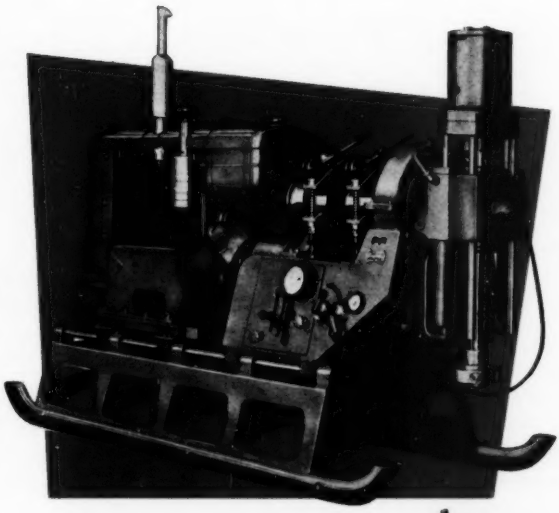

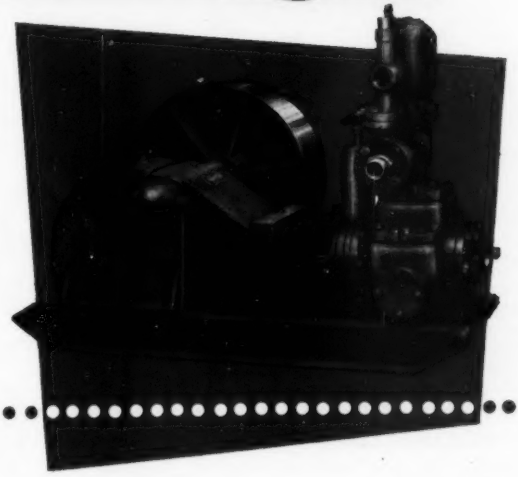

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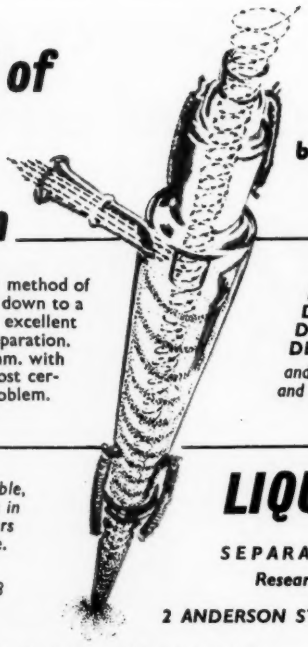

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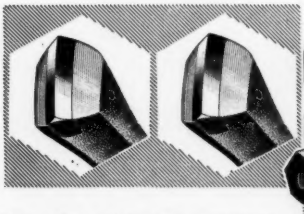

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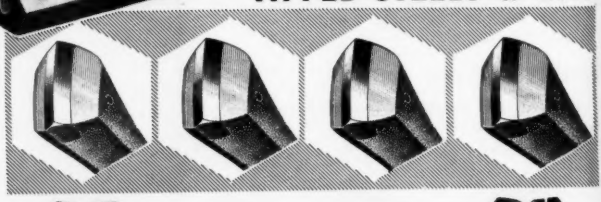

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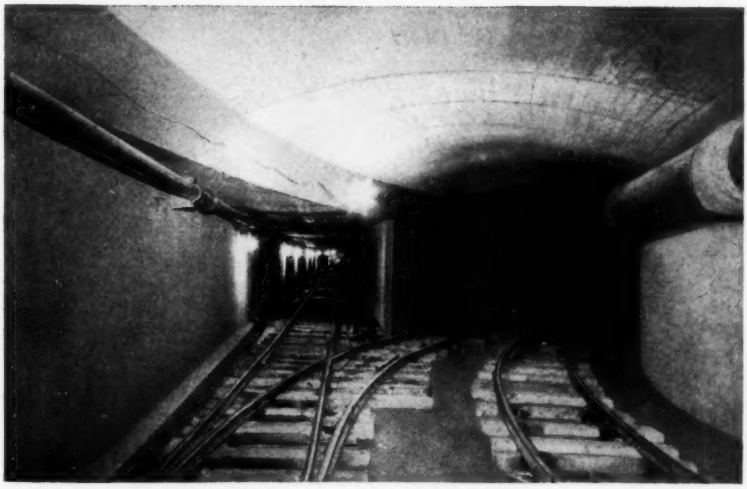

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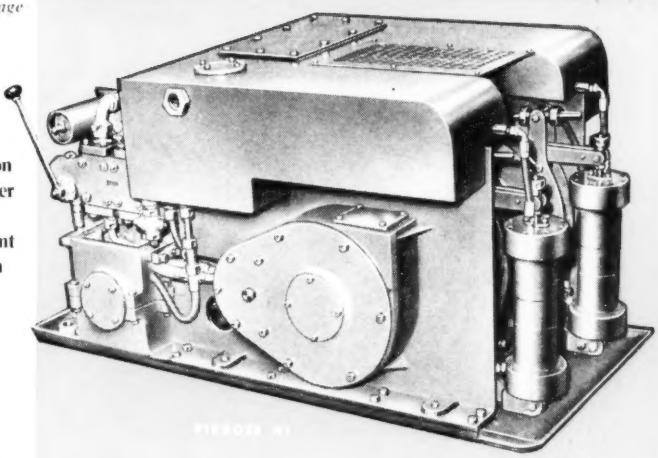

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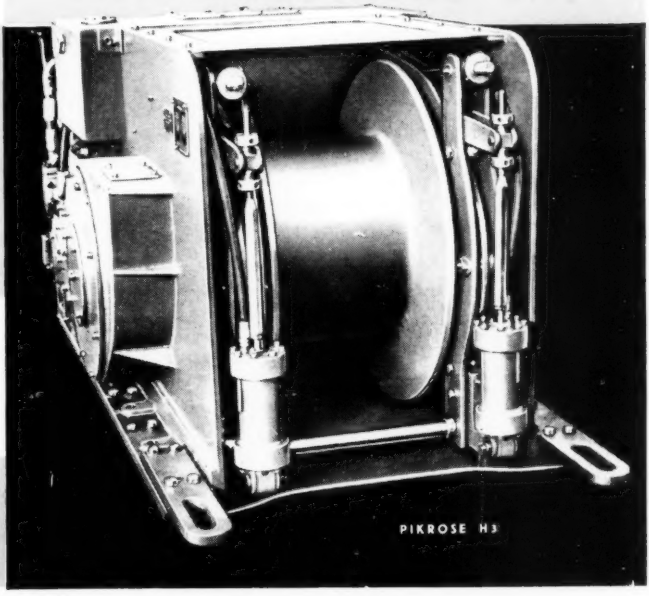

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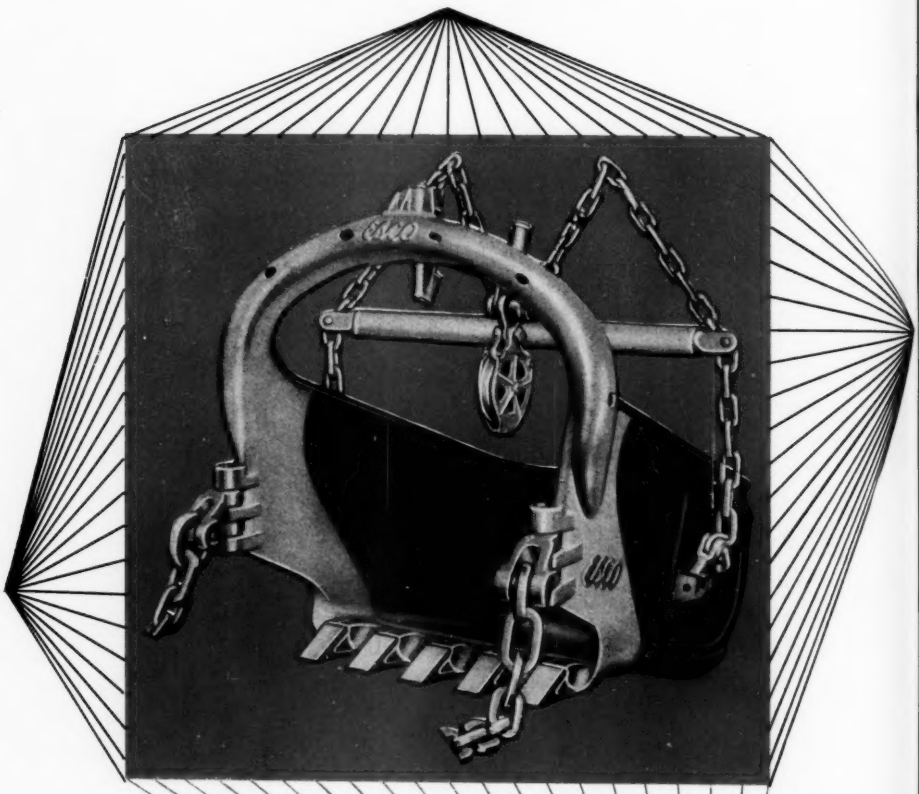

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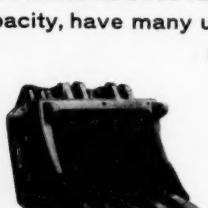

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EDITORIAL

A RECENT report[1] by the Commonwealth Economic Committee consists of a series of separate studies of the raw-materials position in individual Commonwealth countries. These studies bring out the diversity of the progress that has been and continues to be made in the expansion of Commonwealth productive resources and consumption and trade. An introductory chapter refers to some of the most significant developments and brings up to date the principal features of the general review in Volume I published in 1958. The review suggests that the consumption of raw materials in the Commonwealth has grown at least as fast as has that of the rest of the free world due largely to the rising tide of industrialization in primary-producing countries.

THE aerial geophysical survey announced by the Ghana Government as part of their Second Development Plan is expected to play a major part in the investigation of the mineral resources of the country. The two areas concerned are known to be important mineralized zones and cover an area of 4,800 square miles from the coast near Takoradi to Kumasi and 1,800 square miles from Accra across the Volta River to the border of Dahomey. When the photographic flying is complete the camera will be replaced by a magnetometer and a radiation counter, the former to give indication of the composition and geometry of the base rocks in the area and the latter to measure and record variations in the radioactivity on the earth's surface. For the geophysical operation the aeroplane will fly at 600 ft. above the ground on parallel tracks 580 yd apart, to form a grid of survey flight lines over the thickly forested country. It is to assist the navigator to fly these low-level sorties correctly that the mosaics made from the photographic coverage will be used. From the records obtained in this way the Hunting organization will prepare isomagnetic and radioactivity maps for the Government.

Resources of the Guianas

Earlier this month the delegates from British Guiana to the talks on the constitutional future of the Colony assembled at Lancaster House. While Mr. Macleod, Secretary of State for the Colonies, reminded those attending that it had always been the policy of the British Government steadily to lead dependencies towards increasing responsibility for their own affairs and eventual economic stability, the general demand nowadays is for complete independence with full sovereignty and in this respect the Guiana Conference falls into line. Full independence needs an ability to sustain economic expansion and the current talks point the importance of the Fifth Inter-Guiana Geological Conference held in Georgetown in the autumn, the addresses to the opening session of which have recently become available here.

The Conference, which lasted from October 28 to November 6, was, in addition to the large delegation representing the mining companies and the Geological Survey of British Guiana, attended by 37 representatives of government and mining interests in many countries interested in the Colony's development. In the event it was opened by His Excellency the Officer Administering the Government, Mr. D. M. Hedge, who after brief reference to pioneer geological work in the area suggested that the full significance and importance of geology in British Guiana was finally recognized in 1943 when the Geological Survey became an independent department financed under a Colonial Development and Welfare Scheme. Since that time the Department has continued to grow and to-day it is up to a full complement of 19 scientific and specialist officers. Appreciative reference to the work of the Survey was also made by Dr. C. B. Jagan, Minister of Trade and Industry, who said that it was at present working on an urgent project to complete the reconnaissance geological map of the whole colony, a programme which will take five years. When the draft of the new geological map is ready it will be carefully analysed and experts invited to examine it and select areas for airborne prospecting. Special encouragement will be given to qualified companies willing to prospect large areas, on the condition that their campaigns are carried out with promptitude and efficiency. However, Dr. Jagan pointed out that mining investments in the Colony are still being devoted to mineral extraction and processing to a semi-finished

[1] A Review of Commonwealth Raw Materials (Volume I, price 15s. 0d., Volume II, price 35s. 0d.) H.M.S.O.

stage, a process he thought generally true or capital inflow into under-developed territories. An F.A.O. economist, he said, referring some time ago to the weakness of the Caribbean economy had pointed to the dependence of the region on the export of one or two agricultural products and to the import of a wide range of industrial goods, plant and equipment, and even foods. It is patent therefore that standards of living cannot be improved materially so long as the Colony remains a low-wage producer of primary products for export and an importer of finished products of a high-wage economy. He would like to see the smelting of ores into ingots and also the development of ancillary industries carried out in Guiana.

In a concluding address Mr. J. N. Fraser, resident manager of the Demerara Bauxite Company, spoke of recent mining ventures in the Colony, including the manganese project of the African Manganese Company. Regarding bauxite he said that in 1952 the Guianas contributed 37% of world bauxite production. Since then the share of the world total had fallen to about 21% in 1958. On the whole it appeared that the bauxite industry in British Guiana and Surinam had reached the stage where no spectacular growth in production was to be expected. The greater part of the Guiana bauxite is covered with sediments. The deposits easily accessible and close to the surface had been mined out and they were now faced with the task of removing ever-increasing amounts of overburden. In British Guiana they had dealt with this by using a combination of sand pumps and large draglines. Indeed mining techniques in the Guianas had changed radically in the last ten years. If the industry had not brought in new methods, he said, had not invested large amounts of capital, and had not paid careful attention to efficiency, it would not be able to compete to-day. Although there have been no startling developments resulting from new discoveries of bauxite in the Guianas during the six-year period, Mr. Fraser said, a fundamental change has taken place within the industry itself. Rather than being merely suppliers of ore to the aluminium industry the Guianas were now entering a phase of further processing. That development had great significance to the governments of the countries concerned because of the increased revenues they can expect in the future and showed that Dr. Jagan's idea of progress had not been entirely ignored.

Sierra Leone Mining

In a note recently issued by the Department of Information in Freetown it is pointed out that while Sierra Leone's economy is basically agricultural in character the mining industry makes an important contribution to revenue. Illicit diamond mining and dealing caused disruption on a large scale a few years ago, but the position at the end of 1959 appeared to be much more encouraging. Illicit mining is only on a small scale, it is thought, and the fact that the official purchases during 1959 reached a record figure of £5,800,000 seems to indicate that illicit dealing is also decreasing. The note goes on to say that 1959 was a good year for the diamond industry as a whole, for apart from the increases of £1,600,000 in official purchases the Sierra Leone Selection Trust also exported diamonds provisionally valued at £3,300,000, the total legal exports thus amounting to over £9,000,000—a record. In another direction the Sierra Leone Development Company also established a record with iron-ore shipments in 1959—namely, 1,600,000 tons as against the previous best of 1,500,000 tons shipped in 1957. The company is increasing its concentrating mill capacity to 2,000,000 tons per annum as from the end of 1961 and also hopes to exploit new deposits in the Tonkolili District which would permit them to increase the annual exports to 6,000,000 tons.

The position in the chrome-mining industry, the report goes on to say, is not so encouraging. The mineral is mined by the Sierra Leone Chrome Mining Company at Hangha, near Kenema, and shipments in 1959 totalled only 5,000 tons, whereas the figures for 1957 and 1958 were 15,700 and 14,200 tons, respectively. This is due to the competition from the Philippines where chromite of refractory grade has a silica content of 4% compared with the 6% silica content of that shipped from the Hangha deposits of Sierra Leone. Samples of lump ore and of concentrates are being sent to the United Kingdom for treatment in a pilot mill in an endeavour to decrease the silica content to 4%.

Reconnaissance drilling is being carried out in part of the South-Western Province by the Consolidated Zinc Corporation, in partnership with Columbia Southern Chemicals Corporation, to determine the extent of alluvial concentrations of titanium-bearing minerals. Upwards of 1,500,000 tons of alluvial rutile have been proved in one

deposit near Gbangbana, in the Imperi Chiefdom of Bonthe District. Search is also going on for molybdenum in several parts of Sierra Leone. Molybdenite, associated with galena and blende and chalcopyrite and silver, occurs near Dalakuru in the Diang Chiefdom of Koinadugu District. Since 1956 geochemical prospecting research teams from the Geochemical Prospecting Research Centre of the Imperial College of Science and Technology have been assisting the search and the Government Geological Survey is diamond drilling an area with high molybdenum values located by this work. In 1960 a team of two from the Research Centre is to carry out an investigation for molybdenum in the water of streams and water courses in an area of approximately 150 square miles near Lake Sonfon.

Other minerals known to occur in Sierra Leone include bauxite, columbite and ilmenorutile, pyrochlore, gold (alluvial gold mining ceased in 1956, but Government geologists are continuing their efforts to locate lode gold prospects of which several have been found and await evaluation by drilling and assay), platinum, monazite, corundum, cassiterite, talc, and vermiculite. Nepheline syenite rock, which occurs in the Tunkia Chiefdom of Kenema District, is suitable for use in the ceramic and glass industries.

The European Energy Position

A report by the O.E.E.C. Energy Advisory Commission has recently become available.[1] This once again emphasizes the fact that a significant change has taken place over the last few years in the pattern of fuel consumption in Europe. " From what appeared to be a chronic state of shortage of primary fuels, the situation has changed to one of keen competition between alternative fuels." The report re-assesses the prospective energy requirements and supplies of Western Europe, considers the economic, financial, and political problems linked with the future development in the field of energy, and takes particular account of the fact that, since Mr. Louis Armand and the Hartley Commission reported[2] extensive new oil and natural-gas resources have been discovered in Europe, the Sahara, and elsewhere, and that the coal situation has been reversed from a sellers' to a buyers' market, due on the one hand to increasing competition from other fuels and on the other hand to the recent recession.

In its report the Commission regards it as its function to take the long view and try to see through and beyond the present rapidly-changing situation ; what the long-term trends are against which the major investments and other decisions of the energy industries must be made. It considers whether the recent slackening in consumption seems likely to be temporary or long continued and, after having made allowance for alternations of periods of moderate recession and more rapid advance, it arrives at the conclusion that it seems realistic to expect that the future long-term rates of growth of the European economies will continue to be higher than in the pre-war period. Thus it would be a misfortune, it is suggested, if measures that are required in the long term were greatly curtailed or postponed because of short-term doubts about future growth. The total primary energy demand of the O.E.E.C. area is expected to increase by 25% to 30% between 1955 and 1965 and by 58% to 83% between 1955 and 1975. Expressed in terms of million tons of coal equivalent, this represents an increase from 777,000,000 tons in 1955 and 810,000,000 tons in 1958 to 970,000,000 tons to 1,050,000,000 tons in 1965 and to 1,225,000,000 tons to 1,425,000,000 tons in 1975. During this time keener competition between alternative fuels and the possible impact of natural gas and nuclear energy will result, it is thought, in significant changes in the energy consumption and supply pattern in Western Europe.

Summing up its considerations, the Commission suggests a fuller examination be made by O.E.E.C. of the possibilities for the closer physical integration of energy supplies in Western Europe and particularly for the improvement of energy supplies in areas that are at present relatively less well supplied. In the coming months O.E.E.C. will have to study their conclusions and the proposals made by the Energy Advisory Commission in its first report and take appropriate action, by means of international co-operation, in order to solve the problems linked with the future development of Europe's energy demand and supply.

[1] " Towards a New Energy Pattern in Europe." Paris : Organization for European Economic Co-Operation. Price 9s.

[2] " Some Aspects of the European Energy Problem." July, 1955 ; " Europe's Growing Needs of Energy—How Can They Be Met ?" May, 1956.

MONTHLY REVIEW

Introduction.—While business confidence is at the time of writing distinctly disturbed by a downward drift in America the industrial outlook seems to show a sustained improvement. Commodity prices remain firm, with metals still keenly in demand.

Transvaal.—The output of the Rand mines in January totalled 1,701,110 oz. of gold, making, with 34,651 oz. from outside producers, a total of 1,735,761 oz. for the month. At the end of January there were 372,254 natives at work in the gold mines, as compared with 354,058 at the end of December.

Last month the directors of WESTERN REEFS EXPLORATION AND DEVELOPMENT announced that it has been decided to sink a new shaft system (Shaft No. 4) in the northern portion of the company's lease area to permit the exploitation of the northern and north-western sections of the property. The site of the shaft system is about 12,500 ft. north-west of No. 3 Joint Shaft. The new shaft will be 26 ft. in diameter and will be sunk to a depth of approximately 6,700 ft.; it will be divided by means of a concrete wall to provide for both upcast and downcast ventilation and will be equipped for handling men and material, but limited to hoisting 45,000 tons of waste rock per month. No provision is to be made for the hoisting of ore, which will be transferred underground for hoisting at No. 3 Joint Shaft. The capital cost of the new shaft is estimated at approximately £2,900,000, which it is intended to finance from profits. It is hoped that it will prove possible for dividends to be maintained at about the present level during the period of the sinking operations.

The accounts of the CONSOLIDATED MINES SELECTION COMPANY for 1959 show a profit of £299,886 and £369,427 available, of which dividends equal to 2s. 6d. per unit of stock require £167,132. During the year a new subsidiary company—the CONSOLIDATED MINES SELECTION (JOHANNESBURG) LTD.—was registered in South Africa with an initial capital of £120,000 in 240,000 shares of 10s. each, all of which are owned by the parent company. The new company is an investment holding company, its object being to hold, in place of the parent company, South African investments with long-term prospects. It took over from the parent company its interest in the loan syndicate formed to provide part of the initial finance for WESTERN DEEP LEVELS, LTD., with attaching share subscription rights.

The RAND SELECTION CORPORATION reports a group profit of £1,651,109 for the year to September 30 last. Of the total of £1,868,738 available dividends totalling 2s. 9d. a share required £1,031,250.

The operations of the SOUTH AFRICAN TOWNSHIPS, MINING, AND FINANCE CORPORATION in the year ended September 30 last, resulted in a profit of £461,156. A dividend equal to 1s. 6d. a share absorbed £360,000.

Shareholders of HENDERSON'S TRANSVAAL ESTATES have been informed with respect to the offer made to purchase the shares of WITBANK CONSOLIDATED COAL MINES that, although the company has not yet received acceptances for a total of 828,108 shares, it had been decided to acquire the lesser number for which acceptances have been received. Accordingly the Henderson's offer has been made unconditional.

Orange Free State.—The directors of WESTERN HOLDINGS announced last month that bore-hole MH 3, which was drilled approximately 6,800 ft. north-west of No. 3 Shaft and 3,400 ft. south-west of bore-hole FH 2, for the purpose of determining the probable position of the sub-outcrop of the Basal Reef, intersected this reef horizon at a depth of from 3,059 ft. 3 in. to 3,064 ft. 6 in., assaying 12·2 dwt. of gold per ton over a corrected width of 44·5 in., equivalent to 542 in.-dwt. The hole, it is stated, has disclosed the geological information required and, as the core recovery was complete, no deflection is to be made.

Last month shareholders of PRESIDENT BRAND GOLD MINING were informed that in the No. 3 Shaft system the Basal Reef was intersected at a depth of 4,425 ft. below the collar in the ventilation component. The reef was completely exposed over the perimeter of the shaft and the average results of the sampling were as follows: Average channel width, 6·23 in.; average value, 59·23 dwt.; average in.-dwt., 369; average in.-lb. (uranium oxide), 7·84, and average lb.-ton (uranium oxide), 1·26. In the main shaft the reef was intersected at 4,408 ft. below the collar. The reef was faulted and only exposed over approximately 50% of the perimeter of the shaft and the average results of the sampling were as follows: Average channel width, 14·61 in.; average value, 21·49 dwt.; average in.-dwt., 314;

average in.-lb. (uranium oxide), 6·20, and average lb.-ton (uranium oxide), 0·43.

Southern Rhodesia.—The accounts of M.T.D. (MANGULA), for the year ended September 30 last show a profit of £394,224 and an available total of £397,964, of which a dividend equal to 3d. per stock unit requires £225,000. In the year the company milled 736,400 tons of ore averaging 1·224% copper and recovered 16,385 tons of concentrates assaying 51·18%. Plant recovery improved from 91% in 1958 to 93%. At September 30 last the ore reserves were estimated as 25,335,000 tons averaging 1·36% copper. As was noted in the MAGAZINE for March, 1959, a fellow subsidiary of MESSINA (TRANSVAAL) DEVELOPMENT, the MESSINA RHODESIA SMELTING AND REFINING COMPANY, was registered in Southern Rhodesia on April 18, 1959, with an authorized capital of £750,000 for the purpose of erecting and operating a copper smelting and refining plant at Alaska Siding, near Sinoia, to treat concentrates from the Mangula and Alaska mines. It is intended to issue 80% of the capital to the parent company Messina (Transvaal) Development and 20% to M.T.D. (Mangula). Production of fire-refined copper should commence in October, 1960.

Ghana.—In the year to September 30 last the ASHANTI GOLDFIELDS CORPORATION milled 406,365 tons of ore and recovered 321,366 oz. of gold. Operations resulted in a profit of £960,308 after charging £581,921 for taxation and with the sum brought in there was £1,496,108 available. Dividends equal to 2s. a share require £764,742. The ore reserves at September 30 last were estimated as 1,993,105 tons grading 17·2 dwt.

BIBIANI (1927) treated 404,527 tons of ore in the year ended September 30 last and recovered 86,075 oz. of gold, the accounts for the year showing a profit of £9,757 and a total of £273,354 available. Dividends equal to 4s. 8d. a share require £30,625. At September 30 last the ore reserves were estimated as 791,066 tons averaging 5·24 dwt. in value.

The report of KONONGO GOLD MINES for the year to September 30 last shows a profit of £160,981, making with the sum brought in and other items an available total of £263,694. Two dividends declared, equal to 5d. per share, require £89,376. During the year 77,900 tons of ore was treated and 45,941 oz. of gold recovered. At September 30 last the ore reserves were estimated as 188,630 tons averaging 13·6 dwt. in value. The consulting engineer reports that, in general, underground diamond drilling has been directed towards locating continuations of known reefs and the exposure of possible hanging-wall or foot-wall fissures. Except in the case of No. 12 level Footwall Reef results have not been encouraging. A few intersections of low-grade reef are being investigated by cross-cutting. A geochemical survey of the central surface area of the concessions, based on the association of arsenopyrite with gold-bearing reefs, was initiated in June, 1959, and is continuing.

The accounts of GHANA MAIN REEF covering the year ended June 30 last show a profit of £53,828 and a total of £131,495 available for appropriation. A dividend and bonus equal to 6d. a share require £64,076. The ore milled in the year totalled 139,553 tons, which yielded 51,880 oz. of gold. At June 30 last the available reserves were estimated as 279,553 tons averaging 7·97 dwt. in value over 82·3 in. In his review which accompanied the report and accounts the chairman drew attention to two main factors influencing current operations. These were the installation of a single-drum hoist in the Tuappim internal shaft and the decision to develop the known ore shoots to depth as well as laterally. At present, the chairman said at the meeting, the Tuappim No. 8 Level double-drum winder has been fitted with new drum shells and new brakes and is now capable of lifting the full load from 20 Level. The erection of the single-drum hoist capable of operating between No. 20 Level and No. 8 Level in the sinking compartment of the Tuappim internal shaft is progressing satisfactorily and is expected to be completed very shortly. In the Tuappim section the summary of the payable development exposed to date during the current financial year amounts to 520 ft. averaging 9·4 dwt. over 57·3 in. on Nos. 17, 18, and 19 Levels. Before the end of the year it is expected to expose part of the 20 Level. Meanwhile in the Main Shaft section the payable development for the same period amounts to 165 ft. averaging 11·1 dwt. over 43·9 in. on Nos. 13, 18, and 21 Levels. The No. 18 Level drive north and No. 19 drive north and south should be fully exposed before the end of the financial year.

In a reference to AMALGAMATED BANKET AREAS in the February issue it was noted that the Ghana Government was to lend up to £150,000 to the company " for a three-year period." It should be made clear that

the actual amount is £150,000 annually over the same period.

Tanganyika.—Shareholders of TANGANYIKA DIAMOND AND GOLD DEVELOPMENT have been informed that in the December quarter ALAMASI, LTD., treated 75,229 loads of ground and recovered 4,692¾ carats of stones. Excluded were four "specified" diamonds of 14¾, 12½, 10½, and 10¼ carats.

Belgian Congo.—A recent notice to shareholders of the UNION MINIÈRE DU HAUT KATANGA states that in view of the satisfactory results obtained for the financial year 1959 the directors have decided to pay a second interim dividend, "as has been done on one other previous occasion." This interim dividend will be of the same amount as that distributed on January 5, 1960—*i.e.*, 600 Fr., free of tax, per full share, or 60 Fr. per one-tenth of share. In the first two months of 1960 the copper sales price has exceeded that of the preceding months and the market remains relatively firm. "The mining and industrial activities of the Union Minière are being pursued under good conditions. The co-operative spirit of the Congolese and European personnel is excellent," the announcement states.

Australia.—Last month the BROKEN HILL mining companies announced that the mines had returned to full-time working. This is because it had recently been decided by the International Lead-Zinc Study Group, the statement said, that the restrictions imposed last year on the sales of lead are to continue in force. Lead and lead concentrates if produced in excess of the permitted sales quota are to be stockpiled at Port Pirie. Sales restrictions are to be reviewed again by the International Lead-Zinc Study Group in September next.

In the period to December 22 last development at LAKE VIEW AND STAR totalled 7,221·5 ft. of which 4,838·5 ft. was driven to develop the various lode channels, 3,190 ft. or 66% being in ore averaging 6·1 dwt. over a width of 56 in. The main points of interest were, it is stated: In the Lake View and associated mines, or Eastern group, of 1,439·5 ft. driven on various lode channels 930 ft. (or 64·6%) averaged 6·3 dwt. over a width of 56 in. In the Western group of mines driving on the various lode channels totalled 3,394 ft., of which 2,260 ft. (or 66·6%) averaged 6·1 dwt. over a width of 56 in.

GOLD FIELDS AUSTRALIAN DEVELOPMENT reports that in 1959 the Mount Ida mine milled 35,775 tons of ore and recovered 15,860 oz. of gold.

New Zealand.—Shareholders of CLUTHA RIVER GOLD DREDGING have been informed that the reduction of the company's capital has been confirmed by the Court and became effective on February 11, 1960. A further notice says that dredging operations during January and February have been affected by major repairs arising from the failure of the bucket line and the necessity for replacing the top tumbler. These repairs accounted for the dredge being shut down for approximately 15 days.

Malaya.—In the year to October 31 last PETALING TIN treated 3,986,000 cu. yd. of ground and produced 846 tons of tin concentrates. Operations resulted in a profit of £80,955, a total of £221,036 being available. Of this interim dividends declared require £61,600.

Burma.—In the six months to December 31 last the BURMA CORPORATION (1951), LTD., milled 56,457 tons of ore and produced 8,343 tons of refined lead and 737,144 oz. of silver. Other products included 241 tons of antimonial lead, 182 tons of copper matte, 198 tons of nickel speiss, and 8,386 tons of zinc concentrates. The operating profit for the period is given as K 22,95,300, or £172,148. Shareholders are reminded that reference was made in the report for the September quarter to the fall in production of ore from the mine during November and December. The decline in ore extraction mentioned, it is stated, is attributed mainly to the "very heavy repairs necessitated owing to technical and physical difficulties encountered by a succession of ground movements in several sections, an inseparable hazard of mining, which required an unusually high proportion of skilled labour to concentrate temporarily on unproductive but essential repairs and rehabilitation for future production as a result of which mine output is now steadily recovering."

In a circular to shareholders the directors of MAWCHI HOLDINGS state that they have been advised that a resolution for the voluntary liquidation of the Burmese company—MAWCHI MINES (1957), LTD.—has been passed in Rangoon. A circular letter to shareholders informing them of the position and proposals for the future of Mawchi Holdings is to be despatched shortly.

Canada.—It was announced last month that a new mining investment company called LOCANA MINERAL HOLDINGS, LTD.,

has been incorporated in Canada " as a means for British, South African, and European capital to take advantage of Canadian mining opportunities." The company has an authorized capital of 5,000,000 shares of no par value of which 1,200,000 shares are being issued. The offer is made by the DOMINION SECURITIES CORPORATION, LTD., 300,000 of which are being offered to the Canadian public. The company, it is stated, is to invest its funds mainly in the shares of mining companies having their principal activities and interests in Canada. The company believes " that with the guidance of the Canadian executive management and the assistance of the different companies who are the shareholders, it will be in a position, as an investment and holding company, to take advantage of Canadian mining opportunities and also to play a constructive role in the development and expansion of the Canadian mining industry."

Alumasc, Ltd.—Last month the CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA, LTD., announced that it is acquiring a further 46,500 shares of ALUMASC, LTD., a company specializing in the low-pressure die casting of aluminium alloys. The company is a subsidiary of H. E. PROPRIETARY, which is now a wholly-owned subsidiary of Gold Fields. The consideration for the purchase is to be the issue of 37,701 ordinary shares of Gold Fields credited as fully paid.

St. John d'el Rey Mining Company.—At an extraordinary meeting of the ST. JOHN D'EL REY MINING COMPANY to be held in London later this month it is to be proposed that the capital of the company be increased to £1,600,000 by the creation of 300,000 new ordinary shares. It is also to be proposed that an approach be made to the Government relating to a change of domicile.

British South Africa Company. — The accounts of the British South Africa Company for the year ended September 30 last show a consolidated profit of £6,584,138 and a total of £8,863,223 available for appropriation. Dividends totalling 6s. 9d. per unit or share require £3,680,867, while £2,000,000 has been placed to reserve. After other allowances a balance of £2,395,293 is carried forward. In his statement accompanying the report and accounts the president of the company said that CHARTERED EXPLORATION, LTD., which is also conducting prospecting operations for KASEMPA MINERALS, LTD., in the area known as the " Kasempa Salient," hopes in time to prospect in Barotseland proper. In the meantime it is exploring the possibilities of arranging for prospecting to be undertaken in that part of the Balovale District west of the Zambesi River, formerly part of Barotseland.

DIVIDENDS DECLARED

* Interim. † Final.

(Less Tax unless otherwise stated.)

†**Akim Concessions.**—Def. 8½%, Ord. 13%, payable Apr. 2.

†**Calgary and Edmonton Corporation.**—10 cents, payable Apr. 15.

***Central Mining and Investment Corporation.**—1s. 6d., payable Mar. 23.

†**Consolidated Mines Selection.**—1s. 6d., payable Mar. 22.

†**Free State Geduld Mines.**—3s. 6d., payable May 25.

***Gopeng Consolidated.**—3d., payable Mar. 31.

†**Konongo Gold Mines.**—3½d., payable Mar. 29.

†**Larut Tin Fields.**—50%.

***London Tin Corporation.**—20%.

***Mason and Barry.**—12½%.

†**Nigel Finance and Investment.**—6d.

***Pengkalen.**—1½d., payable Apr. 1.

†**President Brand Gold Mining.**—2s. 6d., payable May 25.

†**President Steyn Gold Mining.**—1s., payable May 25.

***Rhodesian Corporation.**—4d., payable Apr. 8.

***Transvaal and Delagoa Bay Investment.**—5s., payable Mar. 21.

†**Welkom Gold Mining.**—3d., payable May 25.

†**Western Holdings.**—4s., payable May 25.

***Witbank Colliery.**—1s. 2d., payable Mar. 17.

METAL PRICES

March 8.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	186	0	0
Antimony (Eng. 99%)	190	0	0
Chromium (98%–99%)		7	2
Nickel (Home)	600	0	0
Platinum (Refined)	30	5	0
Silver		6	7⅛
Gold	12	10	2⅛
Wolfram (U.K.)			
(World)	7	12	0

Tin, Copper, Lead, Zinc } See Table, p. 184.

Mineral Processing Exhibition

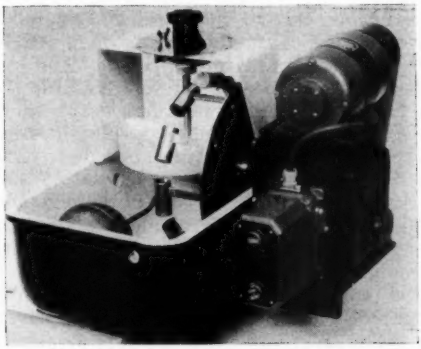
A short guide to some of the exhibits planned for next month's show

As readers will be aware a Mineral Processing Exhibition is to be staged in Church House, Westminster, from April 6 to 9 in conjunction with the International Mineral Processing Congress, 1960, which is being held in the same place. The following notes, based on information made available by exhibitors, will, it is hoped, serve as a useful advance guide to some of the products and activities to be featured.

Edgar Allen and Co., Ltd., are showing a model of a complete and self-contained Portland cement manufacturing plant, having an output of 600 tons per day. The raw materials, limestone and clay, are assumed to originate from the same quarry and these materials when ground are pneumatically blended. An interesting feature of the scheme is the British " Rema " pneumatic preheater. The packing plant caters for bulk and bag loading on to both road and rail transport and is of sufficient capacity to allow of the plant being extended to double the output. The extension foundations are indicated on the model, which is based on actual plant designed.

Davies Magnet Works, Ltd., will have a working model of their small laboratory magnetic separator on view. This model 45 is designed for use also in the field on prospecting duties when electric power is available—220–250 V., single phase, 50 cycles a.c., but it can be supplied wired for alternative supplies by arrangement. Full details will be available regarding the company's other standard units—namely, models 50 and 51 high-intensity non-entraining machines ; model 42 induced-roll take-off machine ; full range of magnetic head pulleys ; model 1 Premier concentrating table ; model 47 magnetic separator ; model 40 drum magnetic separator, and model 26 magnetic suspension blocks.

Denver Equipment Co., Ltd., is to exhibit two units. The No. 7 Laboratory ' Sub-A ' flotation machine is a scaled-down unit of the larger full-size plant machines. This 4-cell unit is suited for carrying out pilot-plant operations and the results obtainable would be exactly in line (cell volume to cell volume) with those of the larger machine. Illustrated here, the new No. 12 Spiral trough wet reagent feeder is a recent development and incorporates several design features which are improvements over the older type. The reagent trough is of a spiral shape fitted to a vertical spindle enabling accurate reagent feeds from 0 c.c. to 1,800 c.c. per min. to be obtained. The control wheel for the trough is now more accessibly placed on the top of the machine and is fitted with locking device, feeder pointer, and graduated scale. A new valve has been developed with fluon inserts enabling corrosive reagents to be satisfactorily handled and also designed to overcome the difficulty experienced with previous models when handling the more viscous reagents.



Denver Equipment Co. Reagent Feeder.

Dorr-Oliver Co., Ltd., will direct chief attention to their A. R. Wilfley and Sons centrifugal sand pump, designed for all types of abrasive slurries, pulps, and slimes. It is glandless and external adjustment is provided

to take up wear, pumping parts being in special wear-resistant alloys. Requiring low maintenance this pump can be provided for volumes of 10 g.p.m. to 3,600 g.p.m.

Other reliable robust low-maintenance pumps for handling abrasive slurries and corrosive fluids in which the company specialize are featured by photographs and include the Oliver diaphragm slurry pump, Dorrco diaphragm suction pump, and A. R. Wilfley and Sons centrifugal acid pump.

Also on display will be DorrClones, which are now widely used for classifying, desliming, and sludge thickening. Other classification equipment includes DSM screens, rake classifiers, sizers, and hydroseparators.

Other display panels will feature the equipment for those operations in which the company also specialize, including filtration, thickening, effluent treatment and fluosolids (for roasting, calcination, and drying). Attention is also drawn to the complete project engineering services which are available.

Float-Ore, Ltd., market a range of flotation reagents for both metallic and non-metallic separation. In addition to standard products new reagents have been developed to suit an ever increasing variety of mining and industrial problems. Prominent among the reagents of particular interest to industry are a number of flocculating agents successfully used in the treatment of trade effluents. Samples of flotation reagents will be displayed on the stand and technical advice given concerning their use on specific problems.

General Electric Co., Ltd., will have as the main exhibit a moving flow diagram illustrating the operation of the heavy-media separation plants manufactured at their Erith engineering works. These plants are provided with the conical type of separation vessel operating with a ferrosilicon or magnetite medium and they are supplied either as semi-portable units with capacities from 4 tons to 150 tons of cone feed per hour or as permanent installations with capacities up to 300 tons per hour per separating cone. At the back of the stand is mounted a drawing of one unit of the washing and screening plant for manganese ore designed and supplied for African Manganese, Ltd., one of which is now in production in British Guiana. The two units are in parallel and each is capable of taking a feed of 125 tons of *minus* 18 in. ore per hour. A selection of photographs of machines and plants made for the mining and allied industries will be included.

Alfred Herbert, Ltd., who are the makers of the Atritor dryer-pulverizer for the controlled drying and grinding of various mineral substances—such as, chalk, clays, gypsum, and limestone—propose to demonstrate this by means of photographs and samples of new and ground material.

The Atritor is a medium-speed air-swept unit which operates in the attrition principle, control of particle size being effected by an integral classifier called a " rejector." Drying is carried out by a supply of hot air induced into the mill from an adjacent air heater which may be coke, gas, or oil fired.

Head Wrightson Colliery Engineering, Ltd., who represent the Mineral Engineering Division of Head Wrightson, will be illustrating on their stand the Stripa process for upgrading poor-quality ores and the cyclone washer system for mineral separation. They will also be displaying a cut away picture of Manvers Main coal preparation plant to indicate the company's interests in the colliery field. Photographs of the drying, grinding, and separation equipment offered by an associated company, Head Wrightson Stockton Forge, Ltd., will be another feature.

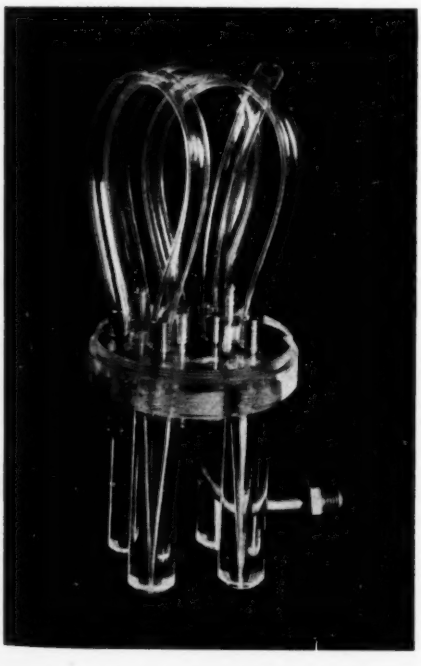
The Stripa process, it is claimed, has the ability to utilize coarse medium solids that are cheap to prepare and simple to reclaim, thereby gaining an advantage over sink-and-float processes that in contrast are relatively expensive. In addition the purchase and use of such materials as ferrosilicon and galena can be avoided. In combination with the Stripa process and the cyclone washer, it is possible to produce an economical plant for accurate separation of differing density materials from a wide range of particle sizes. The development of the cyclone washer separator by the Dutch State Mines has satisfied the requirement for a system capable of equivalent high accuracy in the lower size ranges.

The Stripa trough is a shallow rectangular box supported on flexible rods. Solids of suitable density and size are fed from the cone or cyclone thickener into the trough and form a bed of medium. The ore is fed a short distance from the medium feed point when the process of separating sink and float fractions, which are discharged separately at the end of the trough, becomes possible. The plant includes an adjustable splitter plate directing the products to washing screens and conveyors.

The cyclone washer enables ore of suitable size to be suspended in finely-ground medium. A reduction in the diameter of the apex opening, or an increase of the cone angle, will increase the specific gravity at which the separation occurs. Apparent increases of up to 0·7 are obtainable by the use of suitable medium solids and control of the forces acting within the cyclone.

S. H. Johnson and Co., Ltd., propose to call attention by means of a photographic display to the filter presses and diaphragm pumps they supply. This will be suported by typical examples of materials which are filter pressed and by samples of the results obtained. There is also a display of the wide variety of natural and synthetic filter cloths and papers supplied by their cloth department.

Liquid-Solid Separations, Ltd., will be displaying the following :—A working model of 15 mm. dia. and 30 mm. dia. laboratory hydrocyclones in " Pyrex," a laboratory hydrocyclone test set in " Pyrex," and a 30 mm. dia. hydrocyclone of die-cast aluminium with replaceable moulded-rubber liners and a " Multi-Disc " rubber apex nozzle.



Liquid-Solid Separation Cascade Hydrocyclone.

The 75 mm. dia. hydrocyclone also shown is a new model of cast aluminium with replaceable moulded-rubber liners, interchangeable nylon vortex finders, and " Multi-Disc " rubber apex nozzle. Illustrated here is another new model which is capable of being operated either entirely in parallel or entirely in cascade or any combination. This is the 4 mm. by 15 mm. dia. Multihydrocyclone, of which the standard model is in nylon, but available in other plastics and in larger batteries.

The company also have the following available :—Industrial hydrocyclones in diameters of 150, 300, and 600 mm., 30 mm. Multihydrocyclones, laboratory hydrocyclones, and 75 mm. hydrocyclone pump units, and laboratory testing and consulting services.

Lockers (Engineers), Ltd., will have on show four small electric vibrating feeders which will be in operation. A number of photographs will be included showing typical installations which the company have undertaken for the mining and quarrying industries.

The feeders of which those shown are examples range from capacities of 1,500 lb. per hr. to heavy-duty units for dealing with up to 50 tons per hr. There are also included grizzly feeders and open pan types. The company are also known for their vibrating screens and constant weight feeders.

Neldco Processes, Ltd., are demonstrating, for the first time, the Sala valve model ' C,' which is available in the U.K., and the Sala personal safety block.

Also on show will be a Krebs cyclone with automatic apex valve and photographs of the drying and briquetting equipment made under licence from Conreur Ledent et Cie.

A complete range of descriptive literature of the equipment manufactured by Sala Maskinfabriks A/B, Sweden, will be available.

Nordberg Manufacturing Co., will be directing attention to three of the company's principal products.

The Symons cone-crusher, so widely known in the secondary and tertiary reduction fields, has capacities from 6 t.p.h. to 900 t.p.h. and the machines weigh from 5 tons to 70 tons. Power requirements range from 30 h.p. to 300 h.p. Both Standard and Short Head types are produced.

The Symons " V " screen employs a new principle—*i.e.*, a combination of high speed gyration and drum rotation, giving a greater

screening efficiency and capacity. It is made in one size with mesh area 3 ft. by 12 ft., requiring a 5-h.p. electric motor to drive, vertically mounted. The machine is fully enclosed in a dust-proof and water-tight housing. Weight : approx. 3,900 lb.

The Symons rod deck screen incorporates an arrangement of spring steel rods in place of conventional mesh. The rods may be individually removed, turned, or replaced. The machine can be supplied in sizes from 3 ft. by 6 ft. to 6 ft. by 10 ft. and requires up to a maximum of 10 h.p. ; it is capable of separating very high tonnages of ores and minerals which tend to be difficult to handle.

Patent Lightning Crusher Co., Ltd., in some notes they have supplied regarding their exhibit, point out that during the past half-century the company have pioneered and developed the swing hammer crusher. To-day it has a range of eight standard sizes, which have capacities ranging from approximately 1 cwt. to 80 tons per hour. A wide range of materials can be reduced with a Lightning crusher — asbestos, anthracite, ganister, manganese ore, mica, and slags.

Crushers are also manufactured for the reduction of wet, sticky, or fibrous materials.

The smallest size in the range, the No. " 00," will be shown. This is specially suited for the semi-fine grinding of non-abrasive materials and has outputs of about 1 cwt. to 2 cwt. per hr. when fitted with a screen. This unit is ideal for sample crushing or laboratory work.

Among the other exhibits will be a demonstration working model made in perspex to show the internal workings and selection of crushed samples, showing the variation in the size and shape resulting from experimental test crushings.

Permutit Co., Ltd., will have a photograph exhibit of their large fully-automatic ion-exchange equipment used for recovering uranium oxide from leach liquors. Such plant has been supplied to mines throughout the world and represents the largest non-water application of ion exchange.

Also featured on the stand is the portable " Deminrolit " unit, a small-scale version of their industrial range of plant which produces very pure water for process requirements. The portable " Deminrolit " can produce up to 12 gal. of water hourly having a conductivity of less than 1 micro-ohm per $cm.^3$ and will be of considerable interest to those engaged in assay laboratories.

Ross Engineers, Ltd., intend to display a working scale model of the Ross patent chain feeder similar to a machine of the same type which is at present operating at Mount Ida Mines, North Queensland, to control the feed to an 84 in. by 60 in. jaw-crusher.

Other products in the company's range will be demonstrated by means of photographs, comprising primary crushing plants, which incorporate such items as the chain feeder already mentioned, the drop-bar feeder, and the two-roll grizzley.

Stockdale Engineering, Ltd., specialize in the supply of equipment and complete plant for separation, extraction, and mixing in liquid-liquid and liquid-solid systems. By means of photographs and flow-sheets they will illustrate the range and application of filters, mixers, and extractors for the mineral processing and chemical industries.

R. O. Stokes and Co., Ltd., are to feature four units from their range. The first of these is a 5-spigot Hydrosizer. This hydraulic classisifier is a laboratory version of a device suitable for the treatment of minerals having high economic value. Equipped with a specially designed servo-acting valve for controlling the spigot discharge, it has all the functions of the full-size machine and is capable of handling a *minus* 1 mm. feed at rates between 1 and 1·5 t.p.h.

The double-acting rake classifier shown is a scale reproduction. The interacting rakes are the main feature and provide a considerable but balanced agitation to the pool. The effect of this action is to give an overflow free from surging and also to sharpen the degree of separation, so that the sands emerge with less than the customary entrained fines.

The diaphragm pump finds frequent application in the control of thickener discharges. Two diaphragms share the pumping effort and enable a thick pulp to be handled without trouble and with good life to the wearing parts. All pumps have means for adjusting the stroke and a range is available in which the stroke can be changed while the pump is running.

The vertical sand pump, a $\frac{3}{4}$-in. bore pump which is the smallest of a range designed to give the most flexible operation to any plant pumping operation where a sandy suspension has to be handled. The " drowned " inlet glandless construction enables the feed rate to vary widely without causing any loss of prime.

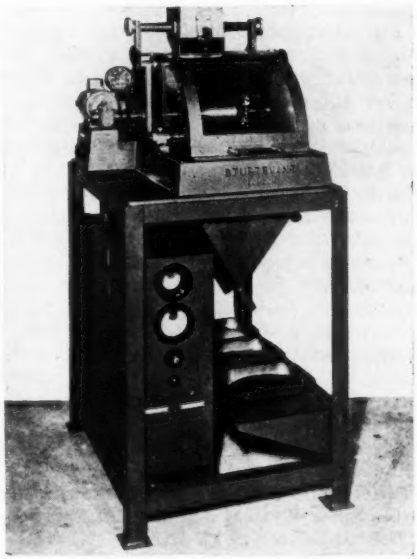
Sturtevant Engineering Co., Ltd., announce that they have recently introduced a new range of high-voltage electrostatic separators, from type O.H., a small laboratory machine, up to large units having outputs of over 4 t.p.h.

The laboratory model to be shown and illustrated here is fitted with a new design of power pack to supply high-voltage unidirectional current, up to 40,000 V. The voltages are indicated on an electrostatic voltmeter and the control panel is also fitted with a micro-ammeter.

The separating zone is enclosed in a cover fitted with large perspex windows. The combination type of electrode permits high rates of treatment with selective separations of some combinations of minerals which hitherto were too difficult to treat. The variables in the machine are all controlled from one position, making it adaptable to any number of tests and permitting reproducible conditions to be obtained rapidly. A shelf is provided beneath the discharge spouts, which will take any suitable receptacles, such as beakers. The hinged cover can be raised to expose the interior, so that the machine can be easily cleaned. Two types of feeder are supplied, one for all normal samples and the other for very small samples and a heater is fitted to raise the temperature when necessary.

The larger machines all operate with the same type of power pack and include similar controls. Standard units are built having two rolls in each, 24 in., 48 in., or 60 in. long.

Wilkinson Rubber Linatex, Ltd., propose to exhibit photographs and models of their products, as well as lined abrasion-resistant equipment. The items will include :—



Sturtevant Electrostatic Separator.

The Linatex centrifugal pump, which is both wear and corrosion resistant and made in ten sizes from ¼ in. to 12 in.

Cyclones lined with the company's Linatex rubber are recommended for use where unlined equipment would be unsatisfactory.

An abrasion-resistant hose incorporating the same material is offered in hoses up to 12 in.

The company's full bore straight-through valve.

The Present State of the Witwatersrand Controversy

C. F. Davidson[1]

A review of recent research

Geochemical Observations

Among the hitherto uncontroverted arguments brought forward repeatedly to support a detrital origin for the Witwatersrand uraninite is the claim that in chemical composition this mineral is more closely related to uraninites of pegmatitic provenance (thus supposedly favouring its

[1] *Continued from the February issue, p.* 95.

derivative nature) than it is to occurrences of a hydrothermal character. Thus Liebenberg (1958, p. 387) writes: "The Witwatersrand uraninite contains up to 2·70% ThO_2. This thorium content is much higher than that contained in colloidal pitchblende deposited from solutions and indicates that the uraninite is of pegmatitic origin." Likewise Ramdohr (1959, p. 26) states: "The ThO_2 content is rather small for pegmatitic uraninite (2·4%), but it is very much too high for a *uranpecherz* of colloidal origin." Here it may be interpolated that Cornish pitchblende from the Geevor tin-copper lode carries 2·05% ThO_2 (Darnley, 1959). Referring to the Blind River ores, Roscoe and Steacy (1958, p. 483) remark: "Uraninite and pitchblende from veins and other definitely epigenetic deposits, so far as the authors can learn, contain less than 0·1% ThO_2. The crystalline uraninite at Blind River contains at least 8·0% ThO_2 with rare earths and is typical of the uraninite found in pegmatites and as an accessory mineral in granitic rocks. It is extremely doubtful that this type of uraninite could be formed in low temperature epigenetic deposits." So much has been made of this point that it merits closer examination.

A complete solid solution series exists between uraninite, thorianite, and cerianite, and from available analyses it appears that in this series the extent of replacement of uranium by thorium and rare earths is in some measure a function both of the temperature of formation of the mineral and of the regional geochemistry. Pegmatitic and other high-temperature uraninites tend to be high in thorium and cerium; and the rather high tenor of these elements in the Blind River mineral suggests, as Heinrich (1958) has already deduced, that the Canadian ores were formed under near hypothermal conditions—a conclusion in keeping with the widespread occurrences of brannerite, which is a relatively high-temperature species.

In addition calcium (ionic radius 0·99Å) may replace uranium (0·97Å) and thorium (1·02Å) to a limited extent. Now, of the principal elements substituting in uraninite, thorium is by far the most dependent upon the vagaries of regional geochemistry. This becomes evident on considering the great range of composition of the mineral monazite, which in a thorium-poor province (Llallagua, Bolivia) may contain as little thorium as 0·001% and in a thorium-rich province (Kerala) as much as 33%. In Haut Katanga uraninite and monazite alike are thorium poor. If, therefore, we are to utilize the chemical composition of uraninite as a genetic criterion, we must eschew consideration of the thorium content but look rather to the ever-present rare earths and calcium. The tenor of rare earths in Rand uraninite, reported at 1·00% (Blyvooruitzicht) and 2·13% (Sub-Nigel), is very much lower not only than that of most high-temperature pegmatitic uraninites, but also than the content in such auriferous hydrothermal pitchblendes as those of Placer de Guadelupe (5·14%) and Swambo, Belgian Congo (2·99%). Similarly, as shown in Table 2, the calcium content of the Rand mineral suggests a hydrothermal origin. If, therefore, the chemical composition of the Rand uraninite is of any genetic significance at all the weight of the evidence does not lean towards a pegmatitic-detrital origin.

Table 2

CaO Content of Uraninites

	%
Blyvooruitzicht	0·81
Sub-Nigel	1·54
Average of 35 pegmatitic uraninites (Frondel)	0·33
Average of 8 lode uraninites (Frondel)	1·31

The widely held view that the banket formations and associated strata are typically low-temperature assemblages, as expressed in the quotation above and in many other publications, has recently been controverted by very pertinent data contributed by A. O. Fuller (1959*a*). Utilizing the widely-tested techniques of Kullerud, Fuller concludes from a study of the iron content in nine specimens of sphalerite from the Bird Reef that the mineralization was emplaced or was last reconstituted at a temperature of 450° C. This is very much greater than can be attributed to depth of burial, and the results can be reconciled with the placer hypothesis only if the high temperature is attributed to the effects of basic dykes or if it is assumed that the extrusion of the Ventersdorp lavas produced hot emanations which permeated the pile of sediments. Fuller inclines to the latter hypothesis, since at least one sphalerite specimen (formed at 464° C.) is from a site far removed from any dyke. But this hypothesis cannot be maintained unless it is demonstrated that the rather abundant sphalerite in the post-Ventersdorp Black Reef has undoubtedly been formed at a much lower temperature. This has not been done. As Fuller himself observes, "the

sulphide mineralogy of ores from the Witwatersrand, Ventersdorp, and Transvaal Systems has much in common despite the apparent divergence in age of the three systems of mineralization." Further, the exsolution relationships of chalcopyrite in sphalerite from the Black Reef, recorded by Liebenberg (1956) and several others, indicate that the temperature there has certainly exceeded 350° C.–400° C. One must deduce either that the initial mineralization took place in post-Transvaal times or that there was a mesothermal metamorphism of the mineralization some time after the Black Reef was formed.

In an equally important contribution Fuller (1959*b*) has lately given a report of investigations on the sedimentary and metamorphic petrology of the Witwatersrand rocks of the East Rand, his results fully confirming the expectation that a wealth of new information would be forthcoming from a study of these strata by modern methods. One of his most interesting discoveries is summed up in the conclusion that pyrophyllite is a common constituent of the sandstones in the Upper Division of the System, which are therefore interpreted as hydrothermally altered feldspathic quartzites. The occurrence of pyrophyllite in the gold reefs has been known for a long time. References to it occur in the writer's mine notes of 1945, probably from information contributed by H. C. M. Whiteside ; and its widespread distribution in the bankets was recognized during the uranium researches of the Government Metallurgical Laboratory and of the Massachusetts Institute of Technology. But the genetic significance of this mineral has not hitherto been appreciated. In discussion Fuller summarizes its relevance as follows :—

> Assuming that the distribution of pyrophyllite suggested by the study of the East Rand section proves to be widespread, we are faced with the problem of accounting for a period of high temperature hydrothermal metamorphism of considerable extent. Laboratory experiments with various silicate assemblages suggest that pyrophyllite forms at about 400–500° C. Such temperatures would pose no problems if the pyrophyllite were restricted to veins in the vicinity of intrusives. But to raise many cubic miles of rock to this temperature is quite another matter. Depth of burial cannot be held responsible although it may have been a factor. The timing of this period of metamorphism will only become apparent when detailed mineralogical studies of Witwatersrand rocks become available from other areas and when similar studies of the succeeding Ventersdorp and Transvaal Systems have been undertaken.

This hydrothermal alteration to which the pile of sediments has been subjected seems to have been of a metasomatic character, locally (perhaps regionally) with major changes in the geochemistry of the rocks. Evidence of this is forthcoming from consideration of the only available analysis of Lower Witwatersrand shale (Table 3), reported by Ellis (1947). This Witwatersrand analysis cannot be matched with that of any normal sediment—but there is a similarity amounting to identity with the Gowcanda (Huronian) argillites in the Blind River and Cobalt districts of Ontario. Roscoe and Steacy (1958, p. 479) note that " pronounced radioactivity has been found in a few places in Gowcanda rocks." Both in the Transvaal and Canadian argillites the composition departs radically from that of an average shale, in possessing an Na_2O/K_2O ratio which is extraordinarily high, in being greatly impoverished in CaO, and much enriched in FeO ; and there can be little room for doubt that the rocks in the two districts have had similar geochemical histories. In a full discussion of the Canadian sediments Pettijohn and Bastron (1959) come to the conclusion that : " The high Na_2O and low CaO content cannot be related either to the source rock or to leaching, but must in some way be related to each other and to a common cause. One is forced to the conclusion that soda metasomatism explains both anomalous compositional attributes." In other words, there has been a widespread albitization with removal of lime and addition of soda. According to several older analyses a high soda : potash ratio and low lime is equally characteristic of the Kimberley shales. Significantly an extensive albitization of the uraniferous Blind River grits has also been reported by Heinrich (1958, p. 263).

There is clearly a great need for much more chemical-analytical work on the Witwatersrand sediments ; but already it is evident that some, if not all, of these strata are not normal sediments at all. As in the rocks containing the equally debated ore deposits of Copperbelt type one finds, at least locally, a marked alkalization which is conceivably linked in some yet unexplained manner with the processes of metallization. This is altogether in keeping with the writer's conclusion that a front of mineralizing fluids stemming from a granitization of Bushveld age has permeated the entire sequence of these strata. It may not be easy to envisage geochemical migrations occurring on a grand

Table 3. Analysis of Soda-Rich Shales

	I.	*II.*	*III.*	*IV.*	*V.*	*VI.*
SiO_2	61·26	61·98	61·68	58·82	61·54	60·76
Al_2O_3	17·30	17·20	16·48	16·46		16·73
Fe_2O_3	1·36	1·42	1·73	1·10		2·53
FeO	7·98	4·49	5·61	7·20		3·85
MgO	1·67	3·27	3·18	4·92		2·49
CaO	0·84	1·00	0·53	0·76	0·84	1·74
Na_2O	4·79	5·27	3·99	4·03	4·73	1·82
K_2O	3·03	2·04	2·62	1·60	2·84	3·41
H_2O+	1·40	2·70	2·95	3·73		3·43
Others	0·96	0·80	1·10	1·19		2·46
	100·59	100·17	99·89	99·87		99·22

I. Lower Witwatersrand Shale. Ellis (1947).
II. Matrix of tillite, Cobalt Series. Collins (1925) quoted by Pettijohn (1959).
III. Varved argillite, Cobalt Series. Pettijohn (1959).
IV. Varved argillite, Cobalt Series. Pettijohn (1959).
V. Argillite, Cobalt Series, Wilson (1913) quoted by Pettijohn (1959).
VI. Average pelitic rock. Shaw (Bull. G. S. Amer., 1956).

scale without recourse to " feeder channels " ; but surely the dolomitization of any massive limestone formation illustrates what is possible in this way. (*Pace* Bosazza (1959*b*), this does *not* mean that the writer attributes the Transvaal dolomitization to hydrothermal action !) The criticism of Bosazza (1959) that the gold mineralization cannot be hydrothermal because there is no wall-rock alteration becomes meaningless once it is accepted that there is hydrothermal alteration throughout the whole sequence of strata.

Another mineral development of unusual interest is seen in the pale chromiferous mica (1·25% Cr_2O_3) which gives the typical green colour to the Hospital Hill quartzites. Frankel (1939), who has studied this occurrence in detail, concludes that the mica is derived from associated detrital chromite—but it has not been explained how alluvial chromite managed to concentrate at this one horizon without any noticeable admixture of the notional detritogenic pyrite, either alluvial or formed by sulphidation of iron oxides. Rather surprisingly, a green chromiferous mica of precisely the same kind is not at all unusual in association with uranium deposits. It is widely developed in the uraniferous and vanadiferous arkoses of Permian age occurring in the Mecsek mountains of Hungary (Kiss, 1958). It occurs extensively in a light-green sandstone near the uranium-vanadium horizon in the Entrada formation of Placerville and of Rifle, Colorado (Heinrich, 1958, p. 405). It is found as a " chrome mica clay " in the uraniferous Wingate sandstone at Temple Mountain in Utah (Kerr and Hamilton, 1958) ; and it occurs in the limestone *wall-rock* bordering thucholite-bearing polymetallic hydrothermal veins at the Black King and White Spar mines at Placerville, Colorado (Hess, 1917). It seems probable that the similarity between these associations is genetic rather than fortuitous.

Recently the distribution pattern of pyrrhotite in the Witwatersrand bankets has been hailed as a " clear demonstration " that the mineralization of the conglomerates is of pre-Ventersdorp age. Thus Nel (1958), quoting a personal communication by J. W. N. Sharpe, states :—

> Pyrrhotite becomes an important mineral in certain areas where the bankets are mined. Invariably the presence of pyrrhotite implies metamorphism and generally thermal metamorphism due to intrusives. Within the bankets mined there is a pyrrhotite-rich aureole around dykes and sills and in many cases pyrite has been completely replaced by pyrrhotite due to the loss of sulphur through the thermal effect. In pyrrhotite-rich areas free gold is seldom present even in rich portions of the reefs, the gold having been taken up by the recrystallized iron sulphide. Even so, no marked variation takes place in the continuity of the pay-shoots so that in spite of the recrystallization the gold shows no marked migration. This effect seems to demonstrate quite clearly that the gold mineralization, at any rate, come before the injection of the intrusives.

The correctness of these field observations is not disputed ; but in the writer's view the deductions that the pyrrhotite represents inverted pyrite, altered under the influence of thermal metamorphism, are radically wrong. It can readily be demonstrated that, instead of providing evidence that the mineralization preceded the intrusives, the distribution pattern of pyrrhotite proves exactly the reverse.

The inversion temperature of pyrite to

pyrrhotite is 690° C. at atmospheric pressure ; 743° C. at a pressure of 10 bars ; and 755° C. at a pressure of 1,000 bars, equal to, say, 13,000 feet depth of burial (Kullerud and Yoder, 1959). Is it seriously suggested that the Witwatersrand sediments ever reached these temperatures, higher (in depth) than the equivalent melting point of granite ? There is no evidence at all of the occurrence of high-grade metamorphic minerals, and pyrrhotite exists side by side with chlorite, sometimes also with quartz and dolomite together. Indeed, the presence of this sulphide as inclusions in the sphalerite referred to above suggests that it formed at no higher a temperature than 450° C. Manifestly, then, the pyrrhotite cannot have been formed by roasting of pyrite. But what is its origin ? It can be explained quite simply as having been deposited from hydrothermal solutions in which the iron : sulphur ratio was higher than that needed to form pyrite. Field observations that pyrrhotite concentrates in the neighbourhood of basic dykes and sills, therefore, point to there having been an increase of iron in the hydrothermal fluids near these intrusions. Young (1917) gave evidence of this when he recorded that " pyrrhotite is usually accompanied by an abnormal amount of chlorite," a point inexplicable on placerist reasoning. It is not necessary to postulate that the iron was derived from the intrusions. A basic mass within the hydrothermal system would inevitably attract ferrous and magnesium ions, like flowing to like. Thus the pyrrhotite aureoles, the precise temperature of formation of which may be extrapolated from the chemical composition of the pyrrhotite (Arnold, 1958), are to be explained not by thermal metamorphism, but by the geochemical gradient which pre-existing basic intrusions have induced in the later mineralizing fluids. In other words, the mineralization post-dates the Ventersdorp volcanism.

The conclusion that there is in general no marked variation in the continuity of gold ore-shoots adjacent to an igneous intrusion does not seem to have any relevance to the origin of the gold. In exceptional cases, however, a noteworthy variation in the tenor of gold has been observed precisely in such an environment. Thus Sharpe himself (in discussion of Liebenberg, 1956) describes an instance where the average gold value rises slowly and steadily from 200 in./dwts. at 109 ft. from a basic dyke to 5,055 in./dwts. at the contact. His explanation that this pattern is due to thermal metamorphism of a placer association (in rocks of feeble metamorphic grade) is not paralleled within the writer's personal experience. On the other hand geochemical gradients against a basic wall-rock are common-place in hydrothermal metallization, and it would seem that in this instance also the basic rock preceded the gold.

Other geochemical arguments have centred upon the platinoid metals present in the bankets. A sympathetic relationship of the Witwatersrand platinoids (rich in osmium-iridium) with gold and uraninite has been demonstrated by Cousins (1957) and, on the assumption that the platinoids are " undoubtedly of placer origin," this is proferred as evidence of the alluvial character of the mineralization. The writer, on the other hand, has shown that this same association is to be found in several auriferous uranium deposits undoubtedly of a hydrothermal character (e.g. the lodes of Athabaska), and that instead of being interpreted as a support for the placer origin of the gold and uranium there are sounder grounds for viewing the relationship as evidence of the epigenetic nature of the osmiridium. This claim is virulently assailed by Ramdohr (1958*abc*) as being " unintelligible geochemical thinking," on the grounds that " primary iridosmine occurs *exclusively* (his italics) in dunites, chromitites, and basic differentiates of the Bushveld Complex and such-like bodies. All occurrences of platinoids in hydrothermal parageneses consist of palladium with subordinate platinum." Unfortunately for this argument neither Ramdohr nor anyone else knows anything about the palladium content of the bankets. Platinoids high in osmium and iridium occur as discrete mineral phases (sysertskite, nevyanskite) and although at their richest these form no more than one part in 50 million of the Witwatersrand ore, they can be recovered readily enough as by-product where physical methods are employed to concentrate the gold. But palladium occurs in nature mainly as a dispersed metal in sulphides, particularly in pentlandite, pyrrhotite, and chalcopyrite (there are no palladium placers around Sudbury, Monchegorsk, or Norilsk !) and so it can be recovered only where leaching of sulphide concentrates enriches the platinoids in an insoluble residual sludge. There is thus no part of the metallurgical flow-sheet in the Witwatersrand where palladium would report, as it used to do in the sludges from the former leaching of high-grade Congo pitchblende. So far as

iridosmine is concerned, had Ramdohr but taken the trouble to refer to the authorities quoted by the writer (1957), he would have found that the content of osmium and iridium in the hydrothermal pitchblende ores of Athabasca and of many other hydrothermal ore deposits is, after allowing for dilution by gangue, of precisely the same order as the overall tenor in the Rand bankets. A closer study of the Witwatersrand literature alone would have brought out the fact that iridium occurs in the auriferous quartz-vein deposits of the Southern Rhodesian Gold Belt (Horwood, 1917, p. 142), in which uranium mineralization, though unusual, is not unknown (Davidson, 1955).

Finally, in a discussion of recent geochemical researches, it is appropriate to refer to the " carbon " in the Witwatersrand and Blind River ores, which has been demonstrated by Bowie and the writer (1951) and by Liebenberg (1956*ab*) to be a form of the hydrocarbon-uraninite aggregate known as thucholite or carburan, akin to the occurrences of this complex recorded from pegmatites, skarns, and hydrothermal veins. Earlier Ramdohr (1950, fig. 431) figured a polished section of the " carbon " without reference to its uraniferous nature, a circumstance difficult to correlate with his claim (1959, p. 24) to have recognized the Witwatersrand uraninite in polished section as early as 1927. In the last few years thucholite has been found to be present in most of the world's uranium fields and an extensive literature on this mineraloid has arisen. It is generally accepted that the thucholite, which is of variable composition, has originated as a polymerization or condensation of hydrocarbon and oxyhydrocarbon gases around radioactive nuclei, a hypothesis finding support in the frequent presence of hydrocarbon gases in mines where thucholite is present, and conversely in the absence of any known occurrence of uraninite free from thucholite within an oil or natural gas province.

Bowie (1958) has recently reported analyses of the natural gas present in the Virginia mine, O.F.S., a mass-spectrographic assay showing methane 76·6%, nitrogen 13·9%, helium 8·3%, hydrogen 0·1%, oxygen 0·2%, argon 0·5%, and carbon dioxide 0·4%. As in other mines where thucholite is present (e.g. Boliden, Dannemora) the helium content is very high and is of course of radiogenic origin. Similarly the argon must be radiogenic. But the source of the other gases is far from clear, since the overall composition falls within the range of gases from coal deposits, gases of metamorphic origin, and gases from eruptive (plutonic) rocks (Kravtzov, 1958). One may presume from the high helium content, however, that there has been little migration of gases from the reefs for a very long period ; and it seems reasonable to suppose either that the heavier hydrocarbons once present have all been converted to thucholite, or that the condensation of methane is still going on to-day. As previously suggested by the writer, an isotopic analysis of the carbon might show whether the ultimate source of the thucholite is magmatic or not. A similar isotopic study of the methane seems to be called for, as a possible clue to the origin of the gas which has given rise to disastrous explosions in Orange Free State mines.

Many years ago Horwood (1917) came to the conclusion that the " carbon " is an epigenetic introduction into the conglomerates, its deposition being " the result of the dissociation of some gaseous compounds of carbon . . . probably attributable to magmatic vapours." This far-sighted conclusion was arrived at following the simple but irrefutable argument that alluvial deposition alone cannot explain a constant association of " carbon " of specific gravity 1·7 with gold of specific gravity 17. To-day it is well known that the " carbon " or thucholite is identical with the carbonaceous matter in the pitchblende veins of the Athabasca Region of Saskatchewan, the Front Range of Colorado, the Erzgebirge of Bohemia and Saxony, and a dozen similar hydrothermal fields, to say nothing of the pegmatites of Karelia, Fennoscandia, Ontario, Quebec, Japan, and elsewhere.[1] Yet Ramdohr continues to asseverate vehemently that thucholite entered the Black Reef as detritus with the gold and that the " carbon " elsewhere was probably engendered from black mud bacteria ; Sharpe submits that the auriferous carbon horizons favoured the development of bacteria and algae, the hydrocarbon granules possibly being the remains of some of the earliest terms of life ; MacGregor supposes that the carbon is derivative from algal peat bogs, which nourished denitrating and other bacteria. Horwood's reasoning is forgotten.

[1] The suggestion (Davidson, 1954) that the concretion-like hydrocarbons in the Mansfeld Kupferschiefer are " almost certainly of thucholite type " has lately been confirmed in a study of these deposits by Schüller (*Abhandl. Deutsch. Akad. Wiss.*, 1959).

The featherweight and the heavyweight lie down side by side; and the bacteria are nurtured solely by the quartz-pebble conglomerates which form the most inhospitable environment imaginable. Truly the banket is a *lapis mirabilis*, for it yields evidences of ancient non-oxidizing atmospheres, the earliest forms of life and strange departures from the law of gravity. No philosopher's stone of the mediaeval alchemists produced a bigger crop of miracles.

Comments on Recent Mineragraphic Research

In the two years covered by this review several repetitive contributions on the mineragraphy of the banket-type ores have been published by Ramdohr (1958*abcde*), the most important of which is a lengthy memoir issued by the German Academy of Sciences in Berlin.[1] In large part these recent works are contumelious rejoinders to the writer's criticisms of this author's earlier monograph, which was first published by the Berlin Academy (1955) and which has recently been reprinted in English translation by the Geological Society of South Africa (1959). The difficulty of distinguishing fact from fancy somewhat limits the usefulness of these recent papers.

Foremost among the mineragraphic arguments in Ramdohr's works, and also in the more fully detailed monographs of Liebenberg (1956*ab*), is the contention that the silt-sized particles of uraninite in the matrix of the bankets must have attained their rounded form by alluvial abrasion. Ramdohr continues to refer to these minute spheroids and ovoids as *Gerölle* (which he translates as "pebbles"), a usage of these terms which is not only quite different from their everyday meaning, but also at variance with the definitions of sedimentary petrologists (*e.g.* Ruchin, 1958, Table 3). This terminology is in itself an illuminating reflexion of the subjectiveness with which the mineragraphic studies have been pursued.

[1] The bibliography of this memoir is interesting. According to the verso of the title-page, it was submitted by its author to a meeting of the Academy on January 24, 1957, approved for printing the same day, and published on November 10, 1958. A large part of the work, however, is based upon publications which did not appear until the end of 1957; and the author (1958*e*) himself notes in March, 1958, that "this extensive paper will probably go to the printer in April." No indications are given as to what sections were approved for printing in January, 1957, and what sections are revisions and additions at a much later date. It is surprising to see a laxness of this kind in a publication of a national academy.

Perhaps it is not altogether surprising that microscopists indoctrinated with placerist conceptions and relatively unacquainted with uranium mineralizations should have jumped to the conclusion that these rounded particles are of detrital origin. What is astonishing is that they should adhere to these opinions so adamantly after time for sober reflexion. In view of the extreme rarity of uraninite as a placer mineral, in view of the unresolved difficulties of accounting for the concentration and rounding of these minute particles if they are detritus, in view of the unsolved problems of explaining how this soluble detritus survived unchanged throughout pseudo-hydrothermal reconstructions in which refractory minerals like gold, ilmenite, and rutile were dissolved and redeposited, in view of the complete topsy-turviness of all the geochemistry involved in placerist claims—it is strange that so little attention has been given to the writer's assertions, printed in 1951 and privately communicated to the South African Government Metallurgical Laboratory some years previously, that the "detrital" structures could be matched in hydrothermal fissure lodes. Recently Liebenberg (1958) has written :—

> The rounded shape of the grains of uraninite is one of their outstanding features and any theory advanced to account for their origin must therefore take this feature into account. To by-pass the uniform shape of the grains of uraninite, hydrothermalists now (*sic*) claim that uraninite can be deposited from solutions as spherical grains especially if the solutions were of low uranium content. Examples and illustrations of spherical grains . . . have been quoted from vein deposits other than the Witwatersrand, but they are completely irrelevant. . . . In these deposits individual spheroids are the exception and not the rule.

In this connexion some recent descriptions of uranium deposits merit the attention of the two mineragraphers. *First*, Leutwein (1957) describes a pitchblende occurrence from the Freiberg vein deposits of the Erzgebirge in the words: "Almost always, pitchblende is only visible microscopically, as small globules lying in quartz or barytes. It is fairly widely developed, but always occurs in very sparse concentrations." *Second*, Mittempergher (1958), in an account of metamorphosed uraniferous sandstones of Permian age occurring in the Italian Alps, writes of the uraninite: "The normal aspect is more or less perfectly oolitic, the individual spheroidal grains are isolated one from another and evenly dispersed throughout the

cement of the sandstone." The " spherulites," already figured in this journal (Davidson, 1958), have a diameter uniformly around 0·01 mm., a value far below the limits of rounding attributable to attrition. *Third*, Tishkin and others (1958) describe and figure from hydrothermal deposits " microcollomorphic spherical formations " of pitchblende in dolomite, from 0·01 mm. to 0·1 mm. in cross-section, and " spherolites " of pitchblende thousandths of a millimetre in cross-section emplaced in a matrix of calcite and hydrohaematite. *Fourth*, and perhaps most instructive, Betekhtin (1958, figs. 95–97) has recently illustrated precisely similar disseminations of uraninite spherules in a matrix of rammelsbergite, the dimensions of the spherules being 20–40 microns with up to 30,000 of them in a cubic millimetre of the arsenide.

These descriptions clearly demonstrate that spheroidal grains of uraninite may be deposited on an immense scale by hydrothermal solutions without necessarily coalescing to form the botryoidal structures characteristic of text-book pitchblende. In this manner alone, and not by attrition, it is possible to explain the formation within the Witwatersrand reefs of rounded uraninite spherules of extremely minute size.

To explain the strange survival of his detrital uraninite and detrital pyrite, Ramdohr (1958*a*) still adheres to a " working hypothesis " of a non-oxidizing atmosphere in pre-Cambrian times—though he is not sure whether it was an atmosphere of methane or of carbon dioxide. He makes analogies with the carbon dioxide atmosphere of the planet Venus—but he does not come down to Earth to perceive that there is no concentration of carbonates in the Witwatersrand or earlier geological systems, and that this hypothetical carbon dioxide atmosphere (because of its " greenhouse effect " in blanketing in the Sun's heat) is quite incompatible with pre-Cambrian glaciation represented by the Lower Witwatersrand tillite. In any case astronomers have no evidence that oxygen is altogether absent from the atmosphere of Venus (Moore, 1958). It may appropriately be noted that the sole " factual " basis for a reducing atmosphere in the pre-Cambrian, derived from early researches on the ratios of sulphur isotopes, has lately been completely disrupted by the investigations of Ault and Kulp (1959) who find no change in such ratios for at least the last 2,000 million years. Ramdohr would have us accept that there was a non-oxidizing atmosphere in Dominion Reef times; in Witwatersrand times—but presumably not when the magnetite shales were being formed; in Black Reef times; and again several hundred million years later when the Blind River placers were laid down. That the haematitic conglomeratic ores of Ghana (contemporary with the Witwatersrand formation) and the coeval Mozaan sandstones of Swaziland accumulated under oxidizing conditions is conveniently ignored. Likewise there is no mention that the mineralization in the Lorraine formation and locally elsewhere in the Huronian of Ontario is of haematitic facies. Recently in discussion of the origin of these banket deposits Amstutz (1959) has stated that were Charles Lyell alive to-day he would not deny the possibility of an oxygen-free pre-Cambrian atmosphere. In the writer's view he would be more likely to demand from the placerists some explanation of the celestial plumbing system whereby their hypothetical reducing atmosphere could be turned off and on as readily as a bathroom shower, and with almost as localized an effect.

In his most recent work Ramdohr (1958*ab*) has made a critical claim, reiterated in several publications, that he has " absolutely unequivocal proof that the whole Witwatersrand mineralization, excluding that of the Black Reef, is of pre-Ventersdorp age." This " proof " lies in a reported discovery that the Ventersdorp lavas have contact-metamorphosed the underlying pyrite-bearing conglomerates, with roasting of pyrite to pyrrhotite, thus making it " completely certain " (*absolut sicher*) that pebbles of pyrite were in existence when the Ventersdorp volcanism set in. Furthermore, uraninite (with the good cleavage supposedly characteristic of an alluvial origin) is well developed in the contact zone and is sometimes enclosed in the newly-formed pyrrhotite. Unlike Sharpe, who as noted above sees large metamorphosed aureoles of pyrrhotite around basic intrusions, Ramdohr claims that this inversion of pyrite to pyrrhotite at the direct contact of reef with lava flows (and with dykes) " doubtless does not go deep, perhaps 5–10 cm." Could these observations and interpretations be relied upon, they would indeed be incontrovertible evidence in favour of the placer theory.

Astonishingly, however, this " extraordinarily instructive " relationship is not

figured in a single one of the 200-odd photographs of these ores published by Ramdohr. He refrains from giving us any detailed description of the critical material. We are told neither the geographical source of the relevant specimen or specimens, nor who collected these rocks, nor when. We do not know whether the material was originally collected for study as metamorphosed rock, or whether the reputed metamorphism was first diagnosed as such in Ramdohr's own laboratory investigations. All we are given is an *ex cathedra* statement by the self-styled *Kenner der Lagerstätte* that his proof in this highly contentious matter is *absolut eindeutig*. In the circumstances this failure to provide reasonable documentation in support of far-reaching claims cannot escape comment. The pyrite-pyrrhotite inversion point at one atmosphere is 690° C.—a figure which may appropriately be compared with the temperature at which basalt lava becomes immobile, recorded by Macdonald (1954) for Hawaiian *aa* as lying ordinarily between 700° C. and 780° C. Jaeger (1957), in the most detailed study yet made on the cooling of dolerite, concludes that in an intrusion with a range of solidification of 1,100–800° C., the contacts are raised to a temperature of no more than 665° C. It is therefore very far from certain that pyrite could have inverted to pyrrhotite by contact metamorphism.

One must also ask how, if the pyrrhotite is metamorphic and formed at just above the inversion point, the rounded grains of uraninite (so abundant that they merit special comment) came to be enveloped by the newly formed mineral? It seems quite clear that these textures can be explained only if the pyrrhotite, like the pyrrhotite occurring in depth, is a product either of primary hydrothermalism (not necessarily at high temperatures) or of a complete pseudo-hydrothermal or metamorphic reconstruction at a temperature far above the inversion point. As Kullerud and Yoder (1959) so pertinently observe, " the presence or absence of pyrrhotite in a pyrite-bearing assemblage is a function of bulk composition and not of temperature as commonly supposed." If the bankets and associated sandstones really have been contact-metamorphosed at well above 690° C. this should readily be evident on petrographic study, for example from an extensive development of micropegmatite and a widespread formation of metamorphic biotite. The complete absence of any petrographical support for Ramdohr's claims, coupled with his failure to furnish a factual account of his critical material, leaves the door wide open for suspicion that once again his conclusions are subjugated to his preconceived opinions. The recorded concentration of pyrrhotite at the contact with Ventersdorp lava can be explained quite simply, within the limits of physico-chemical probabilities, if the basic rocks antedated a hydrothermal mineralization and induced a localized increase in iron within the hydrothermal fluids.

Another recent paper by Ramdohr (1958*d*) deals specifically with the origin of the brannerite which is the principal pay mineral in the Blind River ores. According to Liebenberg (1958) brannerite is absent from the South African deposits; but Ramdohr and Bowie have confirmed the writer's prior suggestion (1957) that some of the " uraniferous leucoxene " and " pitchblende ghosts " in the Witwatersrand are identical with the " altered brannerite " of the Canadians. The Blind River brannerite was early assumed by local geologists to be of detrital origin, a hypothesis finding support in the local occurrence of this mineral in placers in Idaho, Siam, and elsewhere; and in view of the geochemical barriers to the acceptance of an alluvial origin for the uraninite, several Canadian authors (Robertson, 1955; Holmes, 1956; Robertson and Steenland, 1957) have suggested that the uraninite developed as a metamorphic replacement of sedimentary brannerite. From mineragraphic studies, however, Ramdohr now claims that all previous conclusions are false and that he has wholly unequivocal (*völlig eindeutig*) evidence that the brannerite is formed in place by the metamorphism of detrital pitchblende.

This conclusion is seemingly based on the observation that the mineral association uraninite + rutile is rare in the Blind River conglomerates whilst brannerite + rutile, brannerite + uraninite, and brannerite alone are common. Ramdohr deduces the so-called " Pronto reaction " in which rutile combines with " detrital " uraninite to form brannerite, thus: $UO_2 + 2\text{–}3TiO_2 = UTi_{2-3}O_{6-8}$. Significantly the other mineragraphers who have examined Blind River ores find no trace of this combination. To explain the observed mineral associations, however, it is not at all necessary to introduce hypothetical diagenetic reactions with inexplicable thermodynamics. The preferential association of

rutile with brannerite is precisely what one would expect if the mineralization were all of hydrothermal origin, precisely what one finds in brannerite occurrences within hydrothermal vein deposits.[1] The latter interpretation is confirmed by the widespread albitization which accompanies the concentrations of brannerite in the Canadian bankets, just as it accompanies almost all developments of this mineral in hydrothermal lodes and stockworks.

Ramdohr goes on to explain that this " Pronto reaction " is the means whereby re-working of uranium took place in the Blind River bankets. The " detrital " uraninite, he tells us, derives overwhelmingly from old pegmatitic and other deposits " for which an age of 2,000 million years is plausible on geological grounds," whilst the Huronian conglomerates were formed about 1100 m.y. ago and the " Pronto reaction " belongs to the Algonkian orogeny at 800 m.y. ago. In Ramdohr's first monograph (1955) he elaborated the theme that the " detrital " uraninite survived because of a refractoriness due to its extreme youth at the time of its alluvial deposition. From the " Pronto reaction " paper, written in November, 1957, we learn that the uraninite was 900 m.y. old when it entered the conglomerates. A few months later (1958*a*), in yet another monograph, the latter succession of events is valid on pages 17–18, but by page 31, in an attempted refutation of the writer's criticisms, we are back again at the " extreme youth " theory. The discerning reader will find no difficulty in assessing the true value of these contributions.

Much of the confusion concerning the origin of the Blind River brannerite stems from a failure to realize that this titanate is much more widely distributed in hydrothermal deposits than the text-books suggest. Thus S. W. Holmes (1957) expresses a common misconception when he writes that : " The known occurrences of brannerite are all associated with pegmatites, granites, and allied rocks. It has not been found in a hydrothermal vein deposit . . ." In this connexion a list of the occurrences of this mineral, excluding pegmatites and placers, is instructive. It is known : (1) with gold and with molybdenite and other sulphides in quartz veins at Bou Azzer and Tichka in Morocco (Ziegler *et al.*, 1952) ; (2) with uraninite and sulphides at Nichol's Nob and elsewhere in South Australia (Whittle, 1954*a*) ; (3) in the sulphide veins of Chateau Lambert in the Vosges (Geffroy and Sarcia, 1954) ; (4) with gold and uraninite in the hydrothermal copper deposit of Kansanshi in the North Rhodesian Copperbelt (Bowie, 1957) ; (5) with uraninite, coffinite, and anatase, in albite-calcite veins cutting the disseminated uranium ore deposit of Mindola (Nkana) in the same country (Bowie, 1959) ; (6) dispersed in the molybdenite orebody of Climax, Colorado (King *et al.*, 1953) ; (7) with uranothorianite, in stockworks of quartz veinlets bearing a little fluorite and sulphides, cutting the granites of the Ross-Adams mine, Alaska (MacKevett, 1958) and similarly at the Crocker Well prospect in South Australia (Whittle, 1954*b*) ; (8) along the foliation of granite gneisses, with biotite and rutile, in San Bernardino County, California (Hewett *et al.*, 1957) ; and (9) in quartzitic shales and calcareous quartzites, with chalcopyrite and galena, in the Mt. Isa – Cloncurry district of Queensland, near the skarn uranium deposits of Mary Kathleen (Brooks, 1958).

From various unspecified localities in the U.S.S.R. brannerite is recorded (Soboleva and Pudovkina, 1957) in the following associations : (10) in metamorphosed calcareous sandstones, as very small well-rounded crystals found in close association with crystalline rutile ; (11) in metamorphosed, banded, quartzite-ironstones (?taconites) with uraninite, pyrite and other sulphides ; (12) as prismatic crystals in quartz veins with uraninite and molybdenite ; (13) in numerous aplites, albitites, etc., again with uraninite ; and (14), according to Tishkin (1958), in schists, magnetite-amphibolites, iron-quartzites, dolomites, and talc-carbonate rocks, all steeply folded and highly albitized, with nenadkevite (= coffinite) and uraninite. A close association with rutile is recorded in most of these parageneses ; coffinite is not infrequent ; and the mineralization is usually accompanied by widespread albitization. In other words, the mineral association in the ores of Blind River exhibits the characteristic features of brannerite deposits of undoubted hydrothermal provenance.

In these hydrothermal deposits the frequent association of brannerite and

[1] Since this was written, S. Kaiman (*Canadian Mineralogist*, v. 6, p. 389, 1959) has reported the failure of attempts to synthesize brannerite in laboratory environments approximating to geological conditions. The mineral is not produced by sintering uranium and titanium oxides in air at temperatures of well over 1,000° C., and pyrosynthesis is not achieved until the oxides are heated in argon at 1,400° C. !

molybdenite is noteworthy. Molybdenite is not at all uncommon at Blind River. In his latest work Ramdohr tells us that it is allogenic (*i.e.* alluvial) and he also notes the presence of "detrital" molybdenite in the Dominion Reef. It is indeed remarkable that what are apparently the first recorded observations of alluvial molybdenite (a mineral whose hardness is no more than one on Mohs' scale) should have been made, not as one might expect in the study of the clean-up concentrates from placer mining operations but during the microscopic examination of a few polished sections of ore fortuitously collected from the very conglomerates in which that other *rara avis*, detrital uraninite, also abounds. In the history of microscopy the facility with which Ramdohr distinguishes detrital characteristics in the ore minerals of the bankets is most reminiscent of the ease with which the author of *The Nummulosphere* recognized the tests of foraminifera in granites and meteorites.

(To be concluded.)

Tanganyika Mining Industry, 1959

A brief review by the Commissioner for Mines

The continued steady progress of the mining industry in Tanganyika during the year now past is indicated by an increase of nearly £500,000 in the annual value of the minerals exported. For the first time the value of mineral production has exceeded £7,000,000, a record marred somewhat by the announcement that the end of productive life of the Mpanda lead mine is in sight. Exploration has continued in many parts of the country on a variety of deposits and interest is being shown in low-cost ammonium nitrate explosives chiefly by large quarrying operations. Experiments are being conducted at the Mwadui mine, of Williamson Diamonds, Ltd. During the year a revision of the legislation dealing with explosives was undertaken and it is expected that it will be circulated to the industry for review during 1960 before being published as a Bill.

Mineral Production

Diamond production was relatively low during the first few months of the year owing to weather conditions, but in the end it exceeded that of the previous year and was valued at £4,540,000, while for the first time since 1941 exports of gold bullion exceeded £1,000,000. The value of lead concentrates, which include valuable proportions of copper, silver, and gold, was slightly less than that achieved in 1958, amounting to £940,000. These three products form the most important parts of the mineral exports, the total value of which was estimated to be £6,810,000, £470,000 more than the record 1958 figure. Other minerals exported during the year included salt (£114,000), mica (£52,000), tin concentrates (£50,000), and gypsum (£14,000). Exports of garnet, graphite, kaolin, lime, magnesite, and meerschaum continued to be made on a small scale. The value of building minerals, coal, lime, and salt produced and consumed within the territory was estimated to be £364,000, a reduction on the previous year's figure, due largely to the smaller demands of the building industry.

Diamonds.

At the Mwadui mine, which is responsible for 97% of the diamond exports, important progress was made on the technical side. The mammoth 48 in. by 60 in. crusher proved of considerable help in handling the large granite boulders encountered in the gravels early in the year. From the bottom of the opencast pit almost 4,000 ft. of driving was completed in three adits located approximately 120 ft. below the surface for bulk sampling at this horizon, while a new prospect shaft was begun at the edge of the pipe

designed to explore the deposit at greater depths. It had reached 632 ft. at December 31 last. The programme of pitting and diamond drilling continued and the sampling plant (the former pilot mill) was kept busy throughout the year. The main treatment plant handled an average of over 6,600 tons per day.

At the neighbouring property of Alamasi, Ltd., the tonnage and weight of diamonds recovered showed an increase of one-third above the previous year and a new treatment plant of more modern design was almost completed. On this mine also systematic evaluation of the ground was being attempted.

Gold.

The principal mine in the country had a successful year but the Kiabakari mine, of Tangold Mining, is responsible for the significant rise in bullion exports. At Geita, the largest gold mine in Tanganyika, the policy of operating at a reduced tonnage resulted in a higher gold recovery and increased exports. A working profit was achieved for the year. Work on oreblocks in the north end extension to the mine continued, but the nearby property known as " Prospect 30 " which had supplied ore for a number of years was nearing exhaustion.

The Kiabakari mine, in Musoma District, began production in February and, after the usual teething troubles milling settled down to a high degree of efficiency. Development and diamond drilling underground continued to explore and increase the ore reserves. The company was also granted two exclusive prospecting licenses for gold in the district.

The Buhemba mine, also in Musoma District, came under the direct managerial control of Williamson Diamonds and efficiency was improved in all departments. Elsewhere in the Lake Province there seemed to be a revival of interest in gold and the three small worker prospects known as Kabasa, Kilimafeza, and Rwamagasa were all receiving attention from European syndicates at the end of the year.

In the Chunya District the Ntumbi mine maintained its production, but development underground continued to be hampered by inflowing water. Machinery troubles also held up milling. Two small-workers abandoned their attempts to make a living in this field and those remaining reported that conditions were not getting any easier. The majority of the " diggers " working alluvial gold continue to be Africans and other persons attempting this work generally find it uneconomic. From the 87 diggers on record a total of 912 oz. of alluvial gold was sold to authorized dealers.

Lead Concentrates.

At the Mpanda mine of Uruwira Minerals, Ltd., work underground was concentrated on extracting ore from the remaining reserves but development continued to explore all possible extensions of the ore zone both in depth and laterally. Surface prospecting work, conducted by the company and the Department of Geological Survey, failed to reveal any new possibilities and it became regretfully apparent that efforts to increase the life of the mine would not be successful. It was announced that closure about the middle of 1960 must be expected. The treatment process was brought to a high degree of efficiency as a result of experimental work completed by the staff and the mill operated at its normal capacity throughout the year.

Mica.

There was a small but welcome increase in the amount of mica sheet exported by the Jumbadimwe mine, in Mpwapwa District, and the Kabende mines in the Mpanda District closed down. The latter have been important producers for many years. The two African co-operative societies operating in the Uluguru Mountains were again responsible for the larger proportion of the mica sold to the licensed dealers. In Southern Highlands Province the Anglo-American Vulcanized Fibre Co., Ltd., made progress in their efforts to establish themselves in the Tungwa area, exporting mica direct to their factory in London.

Tin Concentrates.

The export of 65 tons from the new mill of the Kyerwa Syndicate, Ltd., is responsible for the notable rise from the Karagwe District. The small-workers' operations were hampered by difficulties of water supply, their output of 28 tons approximating to that for 1958. Exploration work was undertaken by New Consolidated Gold Fields, Ltd., on claims at Kafuro, and in an area of 30 square miles held under exclusive prospecting licence, but results were not encouraging for large-scale mining.

Niobium.

Throughout the year the major effort of the Mbeya Exploration Co., Ltd., at Panda

Hill, was directed to the solving of the problems of extracting the niobium-bearing pyrochlore from its host rock, carbonatite. The preliminary concentrates prepared experimentally in the pilot mill were exported to the Arnhem works of N.V. Billiton Maatschappij, the parent company, for further beneficiation. Until this problem is solved and an economic process developed no decision will be possible on the future commercial possibilities of this deposit.

Other Minerals.

The territorial stocks of salt at the beginning of the year were more than twice normal, amounting to 11,781 metric tons. Nevertheless, production from the 12 coastal works which evaporate seawater and the two inland works which utilize brine springs reached a new record of 36,997 tons. Exports totalled 12,142 tons and were 50% higher than in 1958.

Exports of garnet continued from the deposits in the Masasi District and the company carried out geological and prospecting work in an attempt to establish satisfactory reserves of the material for the future.

The gypsum deposits at Mkomasi, in the Lushoto District, began to show signs of exhaustion and exports were reduced in consequence. Consideration was given to the development of the deposits in Kilwa District, which are of much better quality, but transport costs and communication difficulties prove to be a considerable hindrance in the face of supplies imported by sea from the Near East.

The Tanganyika Corundum Corporation did further work on the ruby-corundum deposit near Longido and a few small specimens of ruby were produced during the year. Efforts continue to find sufficient reserves of the corundum crystals and to interest possible buyers in a somewhat conservative market.

Progress was maintained at the workings of the Tanganyika Meerschaum Corporation and 14 tons of crude material were exported to their Nairobi factory for manufacture into smokers' pipes.

Production from the territory's only coal mine, the Ilima mine, in Tukuyu District, reached 2,194 tons, all of which was sold to tea estates and other local customers.

Enterprise was shown by an African prospector in Pare District. He sent three trial consignments of rich copper ore to the Jinja smelter. The material was obtained from shallow surface workings and the richer ore sorted out by hand picking. It is not known whether these efforts have shown an overall profit, but proceeds certainly repaid smelting and transport charges.

The third deep test well for oil in East Africa was completed by the BP-Shell Company at Mandawa in Kilwa District to a depth of 13,336 ft. The hole proved dry and the site was abandoned. During the remainder of the year operations have been confined to a series of seismic observations on the seabed stretching from the Ruvumu River northwards and including the channels between the mainland and the islands of Pemba, Zanzibar, and Mafia. For the moment operations on the mainland are being concentrated in Kenya.

During the year an oil exploration licence covering two areas in Arusha District and aggregating 2,050 square miles was granted to Mr. Narshidas M. Mehra and superficial examinations of the ground were made. The region is not one which at first sight appears a favourable possibility for oil prospecting.

Prospecting

The Western Rift Exploration Co., Ltd., continued the comprehensive examination of their 34,000 square-mile exclusive prospecting licence. Geological reconnaissance mapping was extended northwards into Mpanda District and a number of areas were examined in detail.

Williamson Diamonds, Ltd., also had a large force of prospectors in the field at the end of the year working principally in areas of the Western, Lake, and Central Provinces.

Considerable progress was made in the estimation of the reserves of phosphate rock discovered at Minjingu in Arusha District by New Consolidated Gold Fields, Ltd., but it is becoming apparent that development will hinge primarily on the cost of transporting the material to the coast. Field tests are meantime being conducted by the Department of Agriculture. Another area which gives promise of revealing a deposit of a similar nature has been found by the Department of Geological Survey, who are examining the occurrence.

There has been a slight resurgence of interest in gold prospects, particularly in the Lake Province. The Overseas Geological Survey carried out airborne geophysical reconnaissance in the Geita District, the

results of which are awaited and which could prove of value for future investigations in this area. Mr. L. Bicchiere was endeavouring to arouse interest in the potentialities of the Iramba-Sekenke goldfield, on which he has been the only worker for some years. He applied for an exclusive prospecting licence covering the whole of it.

The consumption of cement in Tanganyika is approaching that which could support a factory of economic size and interest revived in the possibilities of finding a suitable site. Several inquiries were received and the Tanganyika Portland Cement Co., Ltd., an associate of the East African Portland Cement Co., Ltd., of Mombasa, began an examination of deposits of limestone and clay in the Bagamoyo District. Pitting and diamond drilling is being carried out to attempt to define adequate reserves of the raw materials.

At December 31, 1959, there were 554 prospecting rights current of which 200 were held by Africans. In his speech to the Legislative Council in December His Excellency the Governor announced that courses would be run by the Department of Mines to encourage African prospecting and a decision was taken to hold the pilot course at Morogoro early in 1960.

Ore-Dressing Notes

(5) *Gravity Concentration.*

Jigging (2)

Discussion can now be turned to the jigging operation and its control. The effective components of the oscillating column are :— (*a*) The volume of water in motion above the screen ; (*b*) the horizontal cross-section through which this water oscillates ; (*c*) the rate of change throughout the single jigging cycle ; (*d*) the maximum speed attained by the water ; (*e*) the point of the half cycle at which this speed is reached, and (*f*) the amount of vertical movement per stroke. The energized volume of water (*a*) is produced by the interaction of several factors. These include the length of stroke of the piston or other mechanized driving force mechanically applied at the input end of the column. Next there is the leakage passing the plunger at this end and thirdly there is the effective area of the energizing unit (piston, diaphragm, etc.). Finally there is the effective area of the jig screen—*i.e.*, the open space after allowing for the solid components of the screen and its stationary supports.

These factors then determine the volume of water which rises and falls through the jig screen in each complete cycle. The speed of rise or fall varies from *nil* at the commencement to *nil* at the end, through a maximum which is a function of the volume and the cross-sectional area. This area is modified by the porosity of the jig bed at any horizon and at any moment. This is changing continuously throughout the fraction of a second during which the bed expands or contracts. Thus a jig running at 180 r.p.m. would have three cycles per second and each half cycle would take one-sixth of a second from zero to zero. Such a jig bed probably consists of a mass of particles varying from half teeter to full teeter and never having quite enough time to settle into a locked mass.

In the present discussion the term " plastic " is applied to this bed to indicate the result, that the rapid alternation of strong thrust and weaker return action is keeping the whole of the material more or less mobile.

The fluid normally used in jigging is water, although air has its limited application in the pneumatic jig used in desert countries and for special cases. Attempts have been made to jig in dense-media fluids, but no industrial process of importance has been reported. The water used can be set in motion in several ways. Gentle oscillation between the limbs of a U-shaped box is used in the Baum coal jig, the pulsing force being applied by low-pressure air introduced through valves at intervals, so as to sustain the oscillating action as the water rises and then gravitates back through the material resting on the screen. For heavy minerals a loosely-fitting piston or a flexible diaphragm is used to impart more rapid pulsion strokes, followed by positively powered return (suction) strokes. Abrupt short strokes are possible because water used in this way exerts a plastic thrust rather than streaming action and the particles with the least mass and inertia are most readily set in movement. Before a particle thus urged into motion has time to settle in response to the ensuing suction stroke the next thrust is delivered. The jig bed is thus

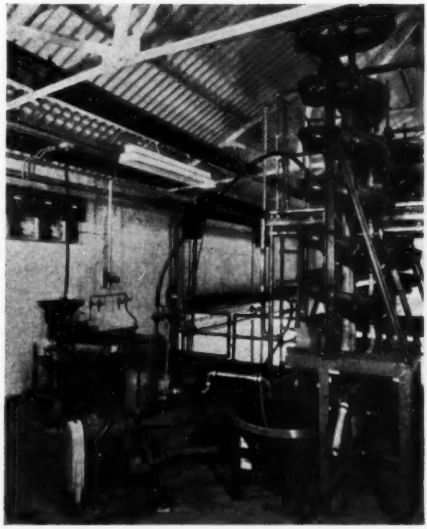
kept in partial teeter, only the upper layers being fairly free to move.

By this relatively violent method of applying force the work is done with a moderate quantity of water in motion. The Denver, Bendelari, and Pan-American jigs use compression in the water chamber instead, while an alternative is to move the jig box up and down in a tank of water (Hancock and Halkyn jigs).

The control factors in through-the-screen (English) jigging are: (1) Length of stroke; (2) strokes per min.; (3) mechanical unbalancing of the stroke-producing device; (4) hydraulic unbalancing by addition of extra water over part or all of the stroke, and (5) thickness, shape, porosity, size, and density of the bedding (ragging) material.

Of these the first four have received detailed attention in the textbooks. A few words regarding item (5) may, however, be justified. It is common to consider the restraining action of the bedding material as serving two main purposes: First, to even the upthrust of the pulsion stroke and thus to prevent "boiling" or break-through of water which would ruin stratification of the feed and, secondly, to form a controlled barrier which makes it difficult for too light a particle to descend through bedding and screen. This is sound enough, but it does not follow that the mass of the particles of sized material chosen to form this bed should be selected simply with respect to the density of particle. It is the density of the bed as a whole which determines its restraining action and this contains two components—the mass of the particles and the weight of water occupying the space between them. It does not therefore follow that bedding which consists of oversized particles of the value being produced as concentrate is most suitable for the work. Neither does it follow that ruggedly shaped particles are the best choice. The distributive function of the bedding during the pulsion stroke is best performed by fairly regular spheres or spheroids, since these and only these will give a smooth and equal distribution to the rising water. In the same way random seizure and entanglement of material which should drop through the bed will be less likely to occur with balls than with irregular objects. The further the bedding departs from a well-rounded shape the less efficiently does it work. This should rule out the use of discs, rivets, steel punchings, and broken ore, although all of these are in common use in jigging. It is, of course, quite possible to do good work with the wrong sort of jig bed. With the right bed still better results will be obtained, since the errors of random penetration no longer need over compensation. The point often escapes notice where an autogenous bed is used, which is composed of closely oversized middlings or concentrates of the mineral being recovered. This is largely due to the fact that such a bed loses its angularity as the sharp corners are worn off and the component particles become rounded.

E. J. P.



Humphreys Spiral in a Test Plant.

(6) *Tailings Disposal.*

Points on Dam Design

The design and location of the tailings dam is an important point in the planning of the new mill. Discussing its pros and cons E. V. Given [1] starts by raising the question of whether one large pond or several small units should be used. Initial costs would be lower with one big dam, but flexibility is lost and isolation during drying and compaction is more difficult. Before construction commences the outline design of pipe-lines, flumes, drop boxes, junctions, and lighting is desirable, together with the decanting system,

[1] *Min. Engg.* July, 1959.

settling and storage, pump-house, and return water. If several dams are to be used the overall area must allow each one to be put on routine operation at shut-down. If there is only one it must be large enough for sections to be isolated while the walls are drying, compacting, and being built.

The minimum area depends on the type of tailings and its slime content as these affect settlement and drying out, a common mistake being to plan on too small a scale so that trouble may be experienced because there is not sufficient time for drying and building the berms. Experience shows that the minimum acreage of 11 or 12 is necessary per 1,000 tons, while most large plants have between 16 and 18 acres per 1,000 tons. This ratio can be reduced if cyclones are used in dam deposition. Berms are usually constructed with a face slope of 1½ to 1 and the material should be compact as they are raised. The ordinary dam-building traffic is enough to ensure this. The top of the initial berm should accommodate a roadway on which heavy equipment can move and the usual distribution of headers, pipes, and so forth can be placed.

Wooden piping is good if it is not allowed to dry out, but concrete or asbestos-cement piping, although more expensive originally, has no further deterioration barring that through abrasion. For a long-term project therefore they are preferable. Water reclamation is an important point and it is frequently compulsory to recover all the water possible. As it collects it should be removed quickly to keep down evaporation and seepage. This is best done by means of concrete ducts laid on the ground under the original berm and extending up-slope through the settling area. Ducts are installed at intervals and are stoppered as the slimes build up to the point where water is being run off. Concrete water towers can be built where necessary and connected to the decant lines on these ducts. Tailings lines are required to distribute the tailings from the main line to the various distribution points.

In the course of the article details of practice at San Manuel, where the distance from the tailings thickeners to the face of the lower dams is about 1¾ miles with a ground slope averaging 5% are given. Pipe-lines are inclined at ½% to keep down abrasion, the slope being adjusted by means of drop boxes 1,200 ft. apart or less and from 12 ft. to 24 ft. high. The tailings run between 44% and 48% solids in a 30-in. wood-stave line, pulp being split and sent to the dams by two 18-in. asbestos-cement lines. Original earth berms are 30 ft. wide at the top and as the dam rises the nearest drop boxes are removed but a sufficient height is kept to deal with the need for a few pounds of pressure into the cyclones from which the tailings are distributed. These cyclones are placed on the inside edge of the berm slanting 15° from the horizontal so that the underflow discharge falls nearest the inside of the dam while the overflow slimes are laundered well in. Berms are built up by dragline as the sands dry out sufficiently to support its equipment. The larger dams are planned for a period of 4–10 weeks' rest between fillings and for a maximum height of between 30 ft. and 35 ft. above the distribution headers. When this level is reached a new service road is built and the distribution header is raised to it and a new dragline berm made ready.

The cyclones have proved most successful in overcoming the difficulty created by having an insufficient acreage available under the system by which the tailings were run direct to the dam. The further advantage is that the coarse tailing fraction segregated near the berm is superior for building up the dam faces.

Book Reviews

Winding and Transport in Mines. By JOHN SINCLAIR. Cloth, octavo, 370 pages, illustrated. Price 60s. London : Sir Isaac Pitman and Sons, Ltd.,

This introductory text-book covering an important phase of coal handling forms another in the series prepared by Professor Sinclair of the University College, Cardiff. Intended for students taking examinations in Great Britain, the author in his preface states that he has considered winding and transport together, with the shaft system an extension of the underground roadways. The whole forms a useful account of colliery practice in this country and as such may have but limited appeal to the metal miner. Nevertheless the treatment accorded his subject is correct in its dealing with principles and in that respect to be recommended.

In ten chapters the book covers ropes, winding gear, and equipment, going on to review winding systems before introducing the student to winding calculations. Then

follow sections on braking systems and various types of haulage, concluding with man-riding arrangements underground. Spoil handling is also discussed, while an appendix covers draft regulations regarding underground trolley locomotives. For students the questions following each chapter will be of use.

The Mines of Cornwall : (1) The Land's End Peninsula. Statistics and Observations by THOMAS SPARGO, 1865. Paper covers, 30 pages, illustrated. Price 4s. 10d. post free. Truro : D. B. Barton, Truro Bookshop.

This reprint of a rare classic will certainly be of interest to all seeking a new assessment of the mineral wealth of Cornwall. The first section of Spargo's work covers properties in the Land's End area, a district containing some of the Duchy's most interesting mines. The description of Botallack, for instance, which the author considered " the most remarkable in the world. . . . the surface works in their position and character, the underground operations, the capital employed, and the results," covers several pages, while that of North Levant, another mine in Penwith, still working as Geevor, is also included.

In his foreword the publisher declares his intention of issuing the remaining parts of Spargo and their appearance will certainly be awaited with interest.

Trace Techniques : Using the K1000 Cathode Ray Polarograph—Vol. I. By J. HETMAN. Paper covers, 48 pages, illustrated. Price 25s. Camberley, Surrey : Southern Instruments, Ltd.

The work under review contains 30 original polarographic determinations using the K1000 cathode ray polarograph. The publishers consider this instrument has contributed greatly to the development of the technique and the meticulous directions given by Mr. Hetman show all details of some ticklish analyses. The useful contribution the book will make to polarography will certainly impress all interested in trace techniques.

Annual Report of the Overseas Geological Surveys, 1957–58. By F. DIXEY. Paper covers, 48 pages, illustrated. Price 2s. 6d. London : H.M. Stationery Office.

This, the first annual report of the Director of Overseas Geological Surveys to be issued as a separate publication, will be a convenience for those interested in the development of British overseas territories. Recent progress is summarized concerning the activities of the headquarters organization in London and of 17 geological surveys overseas, the text being illustrated by seven plates. A comprehensive index to mineral occurrences is provided.

Kempe's Engineers Year-Book 1960. In two volumes in case (3,000 pages), illustrated. Price 87s. 6d., plus 2s. 6d. postage. London: Morgan Brothers (Publishers), Ltd.

The 79 chapters comprising the new Kempe, which cover modern theory and practice in all branches of engineering, have as usual been extensively revised and in places re-written. Alterations and additions due to the issue of new and revised British Standards have also been included, so that this comprehensive treatise remains its authoritative self.

☛ Copies of the books, etc., mentioned under the heading " Book Reviews " can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

Engineering Log

Southern California is only one of several important areas in the United States whose inhabitants face a special kind of water problem. The area is threatened seasonally either by extreme water shortage or dangerous floods and the Los Angeles Department of Water and Power tried for many years to solve the problem by the installation of wooden dams during the low-water season. Such dams divert the water into deep-gallery spreading grounds near by. Thence it is filtered through the soil and pumped from the underground basin to the distribution system for the city. The design of the dams allowed them to wash out and float clear whenever flood conditions arose. This proved an annoyance, since during times of plentiful rainfall no water

was conserved against dry days. There followed the idea of a collapsible dam, inflatable with water to a predetermined height and automatically deflating through a siphoning device as the weight of water surmounting it increased. As the flood subsided the dam could be re-inflated for a resumption of its normal work. For this the material used was neoprene. Reinforced nylon was selected, the dam being made by lap splicing and cementing with a neoprene base adhesive. The final structure was anchored by means of stainless-steel bolts to a concrete channel floor and attached on each side of the channel to vertical concrete walls, at a height of 10 ft., the section lying on the river bottom then measuring 130 ft. in length. In the spring of 1959 the dam was inflated, passed its tests, and went into operation. Exclusive of installation the dam cost $7,100. It is expected to recover annually some 2,000 acre-feet of water, valued at $75,000. Results have aroused much interest from areas with similar problems and from flood-control agencies.[1]

* * *

Leadership in the field of experimental high-energy physics returned for a time to that part of the world where it began when the largest of all the atom smashers reached full power output late last year, several months ahead of schedule. This was at CERN, the European Organization for Nuclear Research, in Geneva. The new synchrotron there produces 24,000 million electron volts (BEV). However, an even more outstanding achievement than the high voltage is the intensity of the new machine's beam, which has a pulse of 10,000 million protons 20 times a minute. All the big machines in use are synchrotrons, the CERN example using a varying magnetic field which holds the accelerating particles in their fixed circular orbit as they are thrust forward to higher and still higher energies. The 24 BEV figure was achieved by using the principle of strong focusing. The ring-shaped magnet is arranged so that alternate sections spread and concentrate the revolving protons, producing a narrower beam and allowing a thinner magnet. Whereas the Bevatron magnet in California weighs 10,000 tons and the Russian magnet 35,000 tons, CERN's is only 3,200 tons and the new machine is equipped with a circular track 100 m. in diameter. A linear accelerator shoots in protons at 50 million electron volts and the protons gain 5,400 electron volts on each circuit, reaching full energy after 500,000 turns; 38,000 kilowatts are required to produce each pulse.[1]

* * *

One of the most difficult problems facing the electrical power distribution engineer to-day is that the industrial load, which is concentrated within the short period between 8 a.m. and 5 p.m. of each working day, is many times greater than the average load required by the ordinary domestic consumer. One way is to "lop" the "peak"—*i.e.*, to keep the "peak" load down by installing emergency generating equipment which will provide additional power when it is required and thereby reduce the demand charge. To this end a British company, Bristol Siddeley Engines, Ltd., has recently designed, developed, and produced a 3-MW. turbo generator, powered by an industrial version of the well-known Proteus aero engine adapted to run on diesel oil. The first of two such sets went into service on December 11 at a site near Princetown, Devonshire. This is a lightweight plant comprising a specially-adapted Proteus coupled to a 3,200-KVA alternator. Starting and shutting down is an entirely automatic process and, in the case of the South Western Electricity Board's set at Princetown, this is done simply by dialling a telephone number from the Board's regional headquarters at Bristol. Compared with a conventional generating set the Bristol Siddeley turbo generator is very small, a station built to house one of these sets needing only to be modestly proportioned and its foundations simple and light, when its cost will be low.

* * *

"Fused-salt-bath electrolysis", a new and simpler method recently developed by the United States Bureau of Mines for selectively extracting tungsten and molybdenum from domestic mineral concentrates, is described in a technical publication just released.[2] The process, it is thought, promises

[1] *Comp. Air Mag.*, Jan., 1960.

[1] *Scientific American*, Feb., 1960.

[2] ZADRA, J. B., and GOZES, J. M. *Rep. Inv. U.S. Bur. Min.*, 5554.

to reduce the costs of producing acceptable-grade tungsten and molybdenum metal powders from scheelite concentrates containing both metals, the separation of molybdenum from such concentrates having heretofore required expensive treatment. The report covers in detail its laboratory work and bench-scale experiments in which commercial-grade tungsten and molybdenum powders were selectively recovered from typical scheelite concentrates in a one-step operation.

* * *

To forward their policy of betterment for the trade and welfare of East Pakistan the Government of that country has decided upon a programme of improvement and modernization for the principal port of Chittagong, on the Bay of Bengal, and the rapidly developing industrial town of Khulna, on the Ganges Delta. The plans for the development of these two cities are to be paid for out of the British contribution to the Colombo Plan funds. Chittagong, an old city with a long history, has been for centuries the main channel of trade for East Bengal and Assam. Tea, jute, raw cotton, rice, and hides are exported, while mineral oil enters and is distributed round the area *via* the Assam–Bengal metre-gauge railway. Situated about 12 miles from the mouth of the Kharnaphuli river, Chittagong is a port of call for quite large ships and since the war has a had good airport. The status of Khulna was much enhanced by the partition in 1947. Until Pakistan and India decided to go their separate ways the whole of the north-east portion of the sub-continent was served by the great city and port of Calcutta, but since 1947 East Pakistan has been cut off from this centre and an outlet has been badly needed for the jute production, in particular, of the area served by the East Bengal standard gauge railway which terminates at Khulna. The town is destined to grow in size and importance, so planned development is both an urgent need and wise precaution. A well-known firm of London architects and planning consultants has been entrusted by the Commonwealth Relations Office on behalf of the Government of East Pakistan with the task of producing plans which will bring these two towns into line with modern trade and industrial requirements and will provide improved standards of living for their populations. To assist the town planners in this undertaking a contract has been awarded by the C.R.O. to Hunting Surveys, Ltd., of London, for aerial photography of the two cities and their environs at 1/10,000 scale.

* * *

A new recording system, half-way between magnetic tape recording and photography, promises to bring about a revolution in its field. The system is capable of recording either in black and white or in colour. The image is stored on what resembles 16-mm. motion picture film, except that no developing is required and the record may be played back immediately. The new process of " thermoplastic recording ", called TPR for short, was invented by Dr. William E. Glenn, physicist of the General Electric Research Laboratory, at Schenectady, New York. The process is based on a film coating which melts readily. To record, varying charges of electric current must be deposited on this coating and this is done by bombing the coating with a fine beam of electrons. The coating is then heated till it reaches the plastic stage, when the electrostatic forces produced by the electric charges wrinkle the surface. Heat is removed and the surface cools and hardens, making the record. The entire process is completed in less than one-hundredth of a second. To erase recorded information, it is necessary only to heat the coating to a higher temperature than that used in recording, so that the electric charge escapes from the softened surface. The recording must be made in a high vacuum, for which a vacuum pump is required. This difficulty is offset by the ability of TPR to store a vast amount of information in a compact length of film. The 24 volumes of one famous encyclopaedia, it is stated, could be stored on a reel no larger than a spool of thread and it could be done in 24 minutes, if the pages could be turned in that time. Costs and performance are still not known and therefore it is too soon to see whether TPR, still in the developmental stage, will challenge existing methods of recording on film and tape. It may well find applications in television, radar, sonar, and infra-red displays, missile guidance, and aerial and space reconnaissance.[1]

[1] *Science News Letter*, Jan. 30, 1960.

One of the incidental problems associated with the development of nuclear power stations was the design of circulators and pumps to circulate heat transfer media. The design of such units set unprecedented problems, but it was found that the solution was to use gas-lubricated bearings. These made commercially possible the design of electrically-driven centrifugal circulators and pumps which could be assembled clean and dry and enclosed so that on installation they were completely sealed from the atmosphere. In Bristol Siddeley gas bearing circulators, for example, the circulating gas fills the body of the unit and serves as the lubricant for the bearings. Once the gas film has been established there is no metallic contact between the shaft and the bearing and no wear should occur. The first such bearing circulators and pumps were developed at the Atomic Energy Research Establishment at Harwell, but their manufacture and later their design as well were undertaken by Armstrong Siddeley Motors and are now an important activity of the Power Division of that firm.

* * *

California's Board of Health has embarked on an anti-smog drive aimed initially at controlling air pollution caused by automobile exhaust. Standards issued by the Board require an 80% reduction in average hydrocarbon emission, with a 60% reduction in emission of carbon monoxide. America's automobile industry has not been caught unawares by this decree, although since 1953 some $6,000,000 has been spent on research on the problem of air pollution. The simplest solution is better car maintenance, but this is difficult to enforce. The outstanding candidate among gadgets offered is a non-catalytic device which can be placed at any point along the exhaust path. It uses a small heat exchanger to concentrate heat sufficient to consume over 90% of the hydrocarbons and 70% of the carbon monoxide. It is said to be more efficient than catalytic types of burner, operating for at least 25,000 miles without diminished effect. It requires special protective metals to enable it to function at 1,500° F. and this increases the cost sharply to $300. A revised version combines the heat exchanger with the exhaust manifold, enabling gases to be burned in the engine at the hottest point of the exhaust stream. The revised model is expected to cost about $200. The cheapest device so far is Ford's 50-lb. unit, containing a vanadium pentoxide catalyst and requiring no more insulation than a conventional silencer since it operates at 700° to 900° F. This device wears out after 15,000 miles and is ineffective against carbon monoxide. However, the most original device using a catalyst is "Pyrocore", made by the American Thermocatalytic Corporation. The catalyst is formed into a porous cylinder and gases pumped in are consumed in flameless combustion as they pass through the pores. Tests show that 99% of the hydrocarbons are eliminated, so that little is left for the nitrogens to mix with. It is said that Pyrocore can be made to last the lifetime of the car and would cost under $50. The American Automobile Association does not plan to enter the burner business and once California has chosen a system, design details will be shared. The problem of crankcase hydrocarbon emission is much less difficult. Many foreign cars imported into the United States already carry a system of piping and valves which carries fumes back into the engine to be burned in the cylinders. All 1961 cars will carry this equipment, and the cost is estimated at $10 per unit. Other areas may well follow California's lead in taking some measures to combat smog. Indeed, the problem threatens wherever traffic is heavy and tall buildings block air circulation.[1]

News Letters

BRITISH COLUMBIA

February 12.

Company News.—The *B.C. Gazette* of January 10, reports the following companies to have been struck from the register: Arcadia Mining Co., Ltd., Atkinson Mining Co., Ltd., Central Mining and Exploration Co., Ltd., Cougar Copper, Ltd., Globe Mining Co., Ltd., Kenneth Copper Co., Ltd., Kildonan Exploration, Ltd., Lynn Creek Zinc Mines, Ltd., MacCulloch Mines, Ltd., Outland Silver Bar Mines, Ltd., Pacific Mining and Smelting Co., Ltd., Trans-Canada Copper, Ltd., United Development, Ltd., Waverly Tangier Mines, Ltd., and Westmill Developments Co., Ltd.

A more rigid enforcement of work requirements under the Mineral Act and Placer-Mining Act of the Province of British Columbia is indicated as the result of two hearings before the Hon. W. K. Kiernan, Minister of Mines. A complaint that insufficient work had been performed on claims held by Canadian American Mining Co., Inc., in the

[1] *Product Engineering*, Feb. 1, 1960.

Omineca mining division, was partially upheld. The company was credited with work performance to the value of $600, but was ordered to pay in addition $1,600 to cover cash in lieu of work, $600 compensation to the Crown for expense involved in the investigation, and $500 compensation to plaintiffs for expense in appearing before the investigating committee. Failure to make payment will entail reversion of the claims to the Crown. In a complaint under the Placer-Mining Act that work on certain claims on Cedar Creek in the Cariboo division had not been performed the Minister warned the operators to be more accurate in the detail provided to the Mines Department.

Vancouver Island.—Shipment No. 8 of copper concentrate to Japan was made on January 17, by Cowichan Copper Co., Ltd., aboard the *Nikkei Maru*. It consisted of 1,400 tons of concentrate containing 740,000 lb. of copper and 4,500 oz. of silver, with a gross value of approximately $220,000. Mr. O. G. MacDonald, the company president, states that revenue from the shipment has enabled Cowichan to pay off the last of its indebtedness, including the balance of $15,400 on the loan for construction of the ocean dock at Hatch Point and the final payment of $10,200 of the 277 acres of land required in the wharf-construction project. In its first two years of production Cowichan Copper has now shipped some 10,500,000 lb. of copper and 56,000 oz. of silver for a gross value of approximately $3,000,000. The December output was obtained from 7,722 tons of ore grading 2·4% copper, from which 668 tons of copper concentrate grading 25·94% Cu was recovered.

Allied Mining Services, Ltd., is meeting with some success in its effort to establish a small high-grade gold-mining operation on the property of Tofino Mines. A considerable amount of work was performed on this property in the past two years by Moneta Porcupine Mines and its associates. On the 1,700-ft. level a vein was found to contain a shoot 45 ft. long assaying 3·32 oz. of gold per ton over an average width of 1·8 ft. Rising from the level below has now disclosed a 60-ft. section of the same vein, immediately below the driven portion on the 1,700-ft. horizon, to carry 4·08 oz. over an average width of 1·4 ft. Mr. David Sloan, who is directing work for Allied, states the next step will be to extend some wing rises in an effort to outline the ore-shoot.

Lillooet.—Some improvement in the operation and development of the Bralorne and Pioneer mines in the Bridge River area has been noted in the quarterly report of Bralorne Pioneer Mines for the last three months of 1959. The Bralorne Division produced 26,045 oz. of gold from 33,075 tons of ore milled in the quarter, while the Pioneer Division produced 8,792 oz. from 20,430 tons. At Bralorne sinking of the Queen shaft was continued and it has now reached a depth of 37 ft. below the 37-level station. Bralorne is British Columbia's deepest mine with the levels established at 1,250-ft. vertical intervals. The main entry is from the 8-level portal at elevation 3,600 ft. All shafts are internal. At Pioneer sinking of the No. 5 shaft was completed to its objective, the 30 level, and a cross-cut has been extended to the "27" vein, on which considerable driving will be done. Development of the "79" vein was continued during the quarter in Bralorne's Queen-shaft area. On the 33 level a shoot was outlined by driving as being 140 ft. long with average width of 3·0 ft. and grade of 0·77 oz. of gold per ton. On the 30 level 55 ft. of driving on the same vein assayed 1·26 oz. per ton over an average width of 4·4 ft.

Some work has been done by Bridge River United Mines since that company acquired the holdings of the former Bridge River Consolidated. Some 350 ft. of stripping has been done on the north end of the "Why Not" vein and the road connecting the Ural tunnel portal with the town of Gold Bridge has been reclaimed and made ready for transport during 1960. Mr. R. R. Taylor, the company president, says the company is negotiating with eastern interests for capital to pursue an active development campaign.

Sale of the Hat Creek coal deposit to the B. C. Electric Co., Ltd., for a reported price of $2,000,000 was announced on February 9, by Mr. Ridgeway W. Wilson, the president of the Wilson Mining Corporation, which holds two-thirds of the stock of the owner—Inland Resources, Ltd. Acquisition of the big coal deposit is understood to have been made as a hedge capable of producing 2,600,000 h.p., while the political struggle over hydro power development of the Columbia and Peace Rivers continues. The Hat Creek property is 20 miles east of Lillooet and about the same distance north-west of Ashcroft, within easy access of the Pacific Great Eastern and each of the trans-continental railways. It has long been known as an extensive lignite deposit, but recent drilling by Dolmage, Mason, and Stewart, consulting engineers, has brought an estimate of reserves in a square-mile section to be 340,000,000 tons with probable reserves of at least the same quantity. The seam has been found to be as much as 2,000 ft. thick. Mr. Ridgeway R. Wilson, now of Santa Barbara, California, and father of Mr. Ridgeway W. Wilson, acquired the property in 1944 for Ventures, Ltd., at a time when he represented the St. Eugene Mining Corporation in British Columbia. In 1946 the Wilson Mining Corporation was incorporated and it became a partner of Ventures in the Hat Creek project and the two companies carried on further work. Ventures sold the controlling interest in 1951 to Inland Resources, a subsidiary of Wilson Mining. The option, now exercised by B.C. Electric, was obtained in 1957 by the Western Development and Power Co., Ltd.

Greenwood.—Continental Consolidated Mines has been accepted for listing on the Vancouver Stock Exchange and shares were called for trading on January 18. The company is developing and mining copper ore at Phoenix. One of its holdings, the Rawhide claim, is being mined on a royalty basis by the Phoenic Copper Co., a subsidiary of the Granby Mining Co.

Revelstoke.—Highland-Bell has acquired all the interest of Barvue-Manitou Mines in Mastodon Zinc Mines and is to proceed to renew production from the Revelstoke property as soon as snow conditions permit. The Mastodon holdings consist of 54 mineral claims on which considerable development work was performed in 1951 and 1952, the ore reserves being estimated at 100,000 tons assaying 20% zinc, with minor amounts of lead. A complete mining camp and plant was erected together with a 150-ton mill. The first productive effort commenced late in 1952 and was suspended after five months because of the drastic decline in the price of the principal product. Mr. Karl J. Springer, the president of Highland-Bell and a director of Mastodon, says that geological studies have indicated a number of new occurrences of high-grade zinc deposition which will be tested by

diamond drilling. He states the new operation will probably ship its zinc concentrate to the Trail smelter. Highland-Bell, Ltd., has been a very successful silver producer at Beaverdell for the past 50 years and has been equally successful in the exploration field in which it has had a heavy participation.

Yukon.—With the value of November, 1959, gold production estimated at $100,000 the total of the 1959 output of Yukon Consolidated Gold will be close to $1,800,000. In 1958 the value of production was $1,670,000.

New Ventures.—Wollclift Pty., Ltd., a wholly-owned subsidiary of Placer Development, Ltd., has purchased all the shares of the S. and M. Fox group of companies, including collieries, trucking, and engineering projects and operations in New South Wales. The collieries are the Wollondilly and Wollondilly Extended mines, in the Burragorang Valley, and the South Clifton mine, in the south-coast field. The engineering works is at Greenacre in the Chullora District, from which centre the main trucking fleet operates. No change in operating plans is contemplated at this time.

Alamos Mines, Ltd., is the new title of the British Columbia company formerly known as Colossus Nickel Development, Ltd. The change is one of name only and was made to conform to the company's current activities in developing the Promontorio mine at Alamos, Mexico. Underground reclamation of the property is continuing.

Sheep Creek Mines, Ltd., has announced it will not exercise its option to purchase all the stock of Venturas Mineras de Mexico S.A. Recent development work on the La Reforma mine has proved disappointing and necessitated a revision of earlier calculations of reserves.

EASTERN CANADA

February 20.

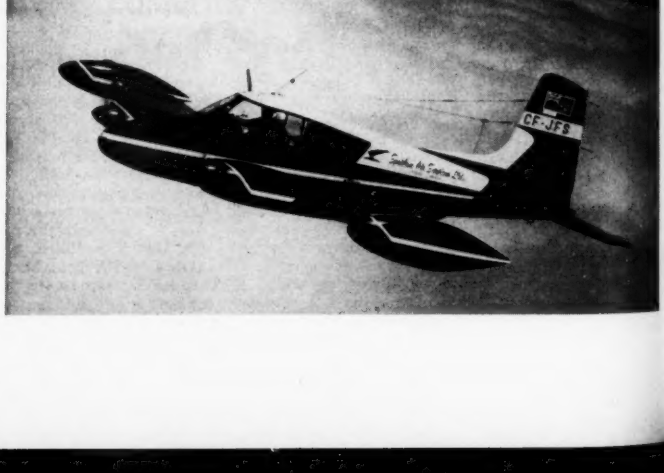
Gold Production.—The output of the gold mines of Ontario for December last included 221,377 oz. of gold and 40,807 oz. of silver, valued at $7,388,654, from 775,803 tons of ore milled. The Provincial *Gold Bulletin* for the month records that for the 12 months of 1959 the 30 producers reported milling 9,224,526 tons of ore containing 2,633,723 oz. of gold and 400,600 oz. of silver with a total value of $88,829,160. In the previous year there were also 30 producing mines and they reported milling 9,309,849 tons, with a content of 2,652,370 oz. of gold and 433,537 oz. of silver, valued at $90,432,750.

Geological Maps.—The Ontario Department of Mines has released Map 1960f, covering the Bigwood Area, in the districts of Parry Sound and Sudbury. This map covers Bigwood township on the north side of the French River south of Sudbury and an adjacent portion of Fifteen Mile Island. Two large bodies of nepheline syenite occur in the area, while other mineral occurrences of commercial interest include quartzite, corundum, graphite, allanite, and radioactive minerals.

Also now available is a preliminary map of the south half of Bateman township, which lies to the north and north-east of a group of producing gold mines. Prospecting activity has been in progress from time to time near the shores of East Bay—the portion of Red Lake that lies within this township. McFinley Red Lake Gold Mines conducted a major exploration programme on their property with much diamond drilling followed by shaft sinking and driving underground workings. At the present time Abino Gold Mines is sinking a shaft.

One of Spartan Air Services' Cessna 310 aircraft which is flying the largest single Government-sponsored airborne magnetic survey ever to be carried out in Canada is illustrated. The aircraft is equipped with the new Varian nuclear precession magnetometer to carry out the job.

Blind River.—The Hon. Robert Winters, president of the Rio Tinto Mining Co. of Canada, Ltd. (RTMC), has announced the plan for amalgamating Algom Uranium Mines, Milliken Lake, Northspan, and Pronto. The plan is the amalgamation of the four companies, preceded by the sale to Northspan by Algom of the Nordic property and the right to deliver 2,470,000 lb. of uranium concentrates; the operation of Algom Quirke property until November, 1966, and of Algom Nordic property until about May, 1965, both at near capacity; the closing of the Milliken, Northspan, and Pronto properties during the course of 1960 and perhaps early 1961, and the conversion of the Pronto mill to treat copper ore from its neighbouring Pater property. The amalgamated company is to be known as R.o Algom Mines. It will have a capital of 12,000,000 n.p.v. shares. Rio Algom will take over the contracts of the amalgamating companies with Eldorado Mining and Refining, Ltd., the Canadian Crown Corporation, for the supply of uranium



Survey Aircraft in Canada.

concentrates. Under this revision it is thought that Rio Algom will be in a better position to compete for its share of the markets in uranium if a substantial commercial demand for the metal developed between 1962 and 1966, or if the demand by Government agencies sharply increased. In a broadcast to the people of Elliot Lake on February 15 Mr. Winters stated that the four amalgamating companies will stand by their obligation to buy back houses from their employees and gave an assurance that Rio Tinto will co-operate with both the Federal and Provincial Governments to encourage new undertakings to come to the area.

Sudbury.—In the 1959 shipping season Steep Rock Iron Mines shipped 2,747,357 tons of ore, more than double the amount shipped in the previous year.

Manitoba.—Drilling at Stall Lake Mines, which lies about 85 miles off Flin Flon, recently showed a section assaying 7·76% copper and 3·34% zinc, with 0·124 oz. in gold and 0·77 oz. in silver per ton, over a width of 18 ft. Earlier sections of equally high grade have already been obtained on this property.

A contract for a new internal shaft (No. 5) at San Antonio Mines has now been let. Situated at the end of a cross-cut on the 3,864-ft. level it is to be sunk 1,000 ft. to enable six new levels to be opened up. A deep ore-body located by diamond drilling is to be explored.

Quebec.—It is expected that the refinery of the Quebec Lithium Corporation will come into production in the near future. With an initial capacity of 5,000,000 lb. of lithium carbonate a year it has been erected in the Val d'Or area.

Shareholders of Consolidated Fenimore Iron Mines have been informed that the Quebec authorities have renewed the iron-ore concession the company holds in the Ungava region. There the area already drilled is said to contain 74,000,000 tons of ore with an average of 25% iron.

AUSTRALIA

February 22.

Industrial.—Australian industry has received two heavy blows in recent awards by the Commonwealth Conciliation and Arbitration Court. The first was the increase of 15s. per week in the basic wage and the second, following almost immediately after, was the granting of an all-round increase of 28% in margins for skill. This country's industries, both primary and secondary, depend heavily upon export and ability to export both primary and secondary products depends upon ability to compete in the world's markets. The Commonwealth is thus placed at a serious production cost disadvantage, aggravated by freight and transport charges to markets, while the mining industry faces depressed world markets for most metals and must now meet not only the direct impact on its own wages bill but also the indirect blow from the repercussion of the awards upon secondary industries which contribute the operating requirements of mining. Serious though the outlook is for the mining industry the labour side is dissatisfied and already movement has been commenced for a further increase in the basic wage by 24s. per week and the restoration of quarterly adjustments to the wage. In addition, there will be a general demand for a 35-hr. working week, in place of the existing 40-hr. week, as well as increased margins for skill.

The demand for reduced hours has been seen ever since the Government of New South Wales, last year, granted a 37½-hr. week to State mine employees, independently of the Arbitration Court, and the unions have not been slow to follow this lead. State governments, as well as other employers, are regarding the position with much disquiet from the angle of their budgets. There is growing opinion that the basis of wage determinations should be reviewed, giving greater regard to the long-range factors that are involved.

The impact of the recent awards is very serious to all industry. To give one instance the black coal export industry of New South Wales, practically defunct, has in the last two or three years been built up close to the £1,000,000 level, through re-organization, mechanization, higher efficiency, and the reduction in costs which has enabled competition with other producers and exporters of coal to Asian markets. This trade may now be lost and the threat of unemployment so greatly feared by the miners' unions before the collieries won their uphill fight may well return.

Japanese smelting interests are keenly interested in obtaining supplies of coal. Possibilities of the Kianga coalfield, 100 miles south-west of Gladstone, Queensland, are under consideration. The proposal covers the mining of 3,000,000 tons of coal by open-cut. The proposition would involve the construction of a railway from Kianga to Gladstone, at an estimated cost of £7,000,000. The Queensland Government appears to be unwilling to build the line, but it is stated that the Japanese steel industry is prepared to finance the construction.

Oil Exploration.—Renewed interest has been aroused by the discovery at Port Campbell, Victoria, of a flow of gas of some 2,000,000 cu. ft. per day in a bore being put down by Frome-Broken Hill, Ltd. The gas was petroliferous and although there have been numerous disappointments arising from gas discoveries in Australia there seemed grounds for hope that Port Campbell offered a reasonable chance of success. Subsequent work, however, has shown that the gas reservoir is small and tests have not shown oil. It is expected that further drilling will be done.

Although a heavy flow of gas has been met at Bwata, New Guinea, tests there have also proved disappointing and the well has been sealed.

The Commonwealth Government has approved of subsidies to companies engaged in the search for oil in Australia, amounting to £610,000, to be distributed amongst 27 companies. Of the sum approved £360,000 will be shared by 19 companies operating in Queensland. The Government has also approved of the increased use of helicopters in the search for oil. Work hitherto has proved the suitability of this aircraft from the viewpoints of area covered and cost in comparison with land parties.

Search for oil has also been active in South Australia, where it is being fostered by the State. The Mines Department is sending a seismic team to use shock-wave techniques along the Birdsville track between Marree and western Queensland and from there the teams will move into the Great Artesian Basin to search for targets. Operations are expected to extend over six months. Geological and hydrological work will proceed simultaneously. Another party, from General Exploration (Australia),

Ltd., will be based on Beachport to operate in the south-east corner of South Australia. The survey will be carried out by Geosurveys (Australia), Ltd., and its operations will include the Mount Gambier area. Estimated cost of the search is £A500,000, which is being subsidized by the Commonwealth Government. Drilling will be carried to a depth of 7,000 ft.

Aluminium.—A factor of great influence in the development of the Weipa bauxite deposit on Cape York Peninsula, Queensland, by the Commonwealth Aluminium Corporation is the supply of adequate and cheap power for a smelting potential of 250,000 tons of aluminium per year. There are three possibilities: The black coal resources of the Queensland coastal country, amongst which is the large Blair Athol coal seam inland from Rockhampton, supported by Callide and Kianga; careful attention to be given to the hydro-electric possibilities of the Purari River in Papua, and the hydro-electric possibilities of the Manapouri-Te Anau Lakes, in the South Island of New Zealand, possibly also a nuclear power plant. An agreement has been signed between Consolidated Zinc Corporation and the Government regarding the New Zealand project under which the Corporation must spend £A25,000 on preliminary investigation and make a decision by mid-1960. If the decision is satisfactory a further expenditure of £100,000 is provided for. If Queensland coal is decided upon bauxite would be shipped from Weipa and aluminium oxide produced and smelted at the source of power on or near the Queensland coast. The cases of New Guinea or New Zealand could involve production of alumina in Queensland and its consignment to smelters at either place, or the shipment of bauxite to the source of power for the whole of the processing. A governing factor will be the nature of the agreement entered into with the Queensland Government.

The bauxite resources in the Darling Ranges, Western Australia, are also of apparent importance and the Western Mining Corporation has advised that scout drilling, sampling, and closer drilling of selected positions has been generally satisfactory. There is a prospect of regular shipments of bauxite being made from Fremantle, following the consignment of a trial lot of 7,500 tons to the Australian Aluminium Commission at Bell Bay, Tasmania. At present the Commission obtains its supplies from Malaya and Indonesia and works requirements are about 52,000 tons per year.

Copper.—Japanese copper-smelting interests are active in their efforts to secure supplies of copper concentrates. For some months negotiations have been in progress with Ravensthorpe Copper Mines, Western Australia, but agreement on terms has not been reached and the discussions have ended. However, it has been reported that a contract has been arranged between Mount Isa Mines, Ltd., and Japanese smelters, estimated to be worth £A4,000,000, while discussions are in progress with Mount Morgan, Ltd., involving 20,000 tons of concentrates for export. Peko Mines, N.L., operating at Tennant Creek, Northern Territory, has also arranged to sell a large yearly tonnage of copper concentrates.

A suggestion has been made that Mount Isa Mines might handle all Australia's copper exports, that company having all the facilities to be the sole exporter. Other producers could replace their share of the export total in home-consumption supplies to Port Kembla. An inquiry is now being made by the Tariff Board into the Copper Bounty and its future. The Bounty expires in June and its retention is of great importance to Mount Morgan, Mount Lyell, Peko, and the Ravensthorpe companies. It is designed to give producers £330 per ton of copper, the basic price being £A285 per ton, increased by a Bounty with a maximum range of £A45, decreased by £1 for each £1 by which the selling price exceeds £285. The Bounty is payable only to those copper-producing companies whose profit is less than 10% on the capital employed. Mount Isa Mines does not participate in the Bounty.

Tableland Tin.—Tableland Tin Dredging, in North Queensland, is now the largest tin producer in Australia, with an output that has again reached 70 tons of tin oxide per month. Operations are now held up by the capsizing of the dredge. Work is proceeding to right it, but operations cannot be resumed under some three months at a cost of probably £A100,000. The idle period will cause a large reduction in the country's output for the current year.

Opal Mining.—Production of opal has been essentially an Australian industry although a minor one. The principal producing States are New South Wales, South Australia, and to a lesser extent Queensland. The largest buyer for a considerable time has been the United States of America, which in 1958 took opal to the value of £A74,393. Japan has now become the leading importer and purchases have risen from £A5,780, to £A164,969 in 1958. Producing fields are Lightning Ridge, in New South Wales, noted for black opal, and Coober Pedy and Andamooka, in South Australia, noted for lighter-coloured products. The original opal field, White Cliffs, in New South Wales, is now of small importance.

The industry has been one of hand mining by individuals, but has been expanded into larger-scale operations using earth-moving equipment to expose the opal-bearing beds. Although there is risk of destroying good stones success is claimed for the new method of mining. It is hoped that by this means new opal deposits may be disclosed.

Iron Ore.—Prospecting for iron ore is active and the Western Australian Government is concerned in the search, having as an objective a State-owned integrated iron and steel enterprise. The largest iron-ore deposits in the State are at Yampi Sound and are held and worked by the Broken Hill Proprietary Co., but there is a large number of smaller deposits about which much has yet to be learned as to tonnage and grade. A serious factor in their consideration is that of transport of ore to works, for deposits are scattered over a wide area and transport can be expected to add substantially to costs. The State already has a charcoal iron industry in the Darling Ranges, east of Perth, and it is understood that an export trade is being developed.

Broken Hill Proprietary intends to spend £A6,300,000 at Yampi Sound. The company is already mining ore at Cockatoo Island for shipment to Port Kembla, New South Wales, and development work has been in progress on the neighbouring Koolan Island, where extensive geological and diamond-drilling work has been carried out. Operations are near the production stage and the plant will have a productive capacity of 2,000,000 tons of ore per year. Construction work involves the building of a town, cargo wharf, and airstrip

as well as roads. Water supply is a problem which will doubtless be met as has been done at Cockatoo Island, where water is brought as back loading in the ore ships from Port Kembla, New South Wales.

New Guinea.—Mining is practically confined to the operations of Bulolo Gold Dredging, supplemented by the lesser scale work of New Guinea Goldfields, and individual production. Proposals for intensified mineral search have not materialized. A major industry is the search for oil by an association of several large Australian and overseas oil companies. However, an event of interest has been the resumption of work at the Lakekamu Valley goldfield, which has been idle since the beginning of the war and which prior to that had produced 40,000 oz. of gold. The airstrip has been re-opened and drilling equipment is being flown in by Bulolo Gold Dredging. Bulolo, it seems, is nearing the end of its ore reserves, but still has several years' life ahead of the one remaining dredge and the sluicing operations which are working ground of good grade.

Great Victoria Lease.—Great Western Consolidated N.L., one of the Western Mining Corporation group, has commenced mining on the old Great Victoria lease at Burbridge, south of Southern Cross. The mine was discovered at the beginning of the century and was worked with some success for a number of years. The lode is an extensive laterite occurrence of low grade—under 3 dwt. gold per ton. It had several active periods, the last ceasing in 1951 ; low grade of ore and rising costs made it a difficult economic proposition. The mine has been worked by open-cut, but extensive sampling is essential to delineate the payable sections of the large laterite body.

Central Norseman.—in the Regent Shaft area, on the Crown Reef at Central Norseman, three winzes from No. 16 level were in good ore at last report ; one gave values of 6·3 dwt. over 48 in. for a depth sunk of 44 ft. ; a second averaged 14·3 dwt. over 48 in. for a distance of 12 ft. ; the third winze was in ore assaying 10·0 dwt. over 48 in. for an inclined depth of 50 ft. Driving at Nos. 22 and 27 levels was in low-grade ore. On the No. 5 level of the Princess Royal Mine a south drive was advanced to 107 ft. from the crosscut off the 31150 Surface Winze ; assay value from 15 ft. to 107 ft. was 26·5 dwt. over 51 in. Driving at No. 6 level was in ore assaying 9·9 dwt. over 84 in. from 5 ft. to 71 ft., thence low grade material.

Great Western Consolidated.—An interesting development at this company's Nevoria mine was the cutting of the lode at No. 4 level in the south cross-cut ; from 398 ft. to 408 ft. the assay value was 8 dwt. per ton. The west drive on the north lode was in average-grade material of 3·3 dwt. for 59 ft.

FAR EAST

February 6.

Tin Industry in Malaya.—The Federation produced 37,525 tons of tin last year and at December 31 there were 483 mines active, the highest number at any time since tin restriction started in December, 1957. As compared with pre-restriction days there were about 35% fewer miners at work.

Sir Vincent del Tufo, Malaya's permanent representative on the International Tin Council, arrived recently in Kuala Lumpur on a three-week visit at the invitation of the Federation Government. He was expected to discuss the proposed new draft international tin agreement with leaders of the industry.

The Federation Government's mineral investigation drilling unit is to carry out tin prospecting in reservation areas, this move being a result of the plan to encourage Malays to take part in the mining industry. Tun Abdul Razak bin Hussein, Minister of Rural Development, said that a recommendation about this matter by a working party had been accepted by the National Land Council. The results of the prospecting would be submitted to the state governments, which would select areas of tin-bearing land and encourage applications for prospecting licences and mining leases from Malaya individuals, companies, or co-operative societies.

The Associated Malay Chambers of Commerce have offered to help the Government in its plan to encourage Malays to take part in the tin-mining industry. In a statement in Kuala Lumpur it was said that applications for prospecting in selected areas should be scrutinized to make sure they came from genuine Malay business men ; otherwise the plan would fail. The statement went on : " There have been attempts in the past by Malays to enter the tin industry but lack of prospecting experience and capital have been a setback. The Malays are not business-conscious, and unity among them is lacking. Nevertheless, they are not wanting in able men to carry out prospecting."

The Government is to build up a corps of Malay mining engineers and technicians to enable Malays to take part " in open competition " in the tin-mining industry, a recommendation to this effect having been made by a working party and adopted by the National Land Council. Announcing the decision, Tuan Haji Khalid bin Awang Osman, Assistant Minister of Rural Development, said in Kuala Lumpur that the Government would build up the corps in conjunction with state governments. It would offer four scholarships annually for seven years to suitable Malay candidates to qualify as mining engineers. Selection would be done with the help of the All-Malaya Chinese Miners' Association and the F.M.S. Chamber of Mines. The candidates would not be taken into Government service on completion of their studies. The Government is also to offer bursaries to Malays at a technical college to match the intake of other mining engineers and carry out a survey and select sponsors to train Malays at all levels of the mining industry where special skills were needed.

A dredge and two small Chinese-owned tin mines in Malaya had to stop work recently while a 250-lb. bomb, found in a dangerous condition in their vicinity, was exploded by army engineers. The dredge, belonging to Sungei Kinta Tin Dredging, had unearthed the bomb, which was towed 400 yards out of the way.

Iron Ore.—The output of iron ore by Eastern Mining and Metals Co., Ltd., at Dungun, Malaya, is expected to rise considerably this year ; the mines there produced 1,950,000 tons last year.

Mr. J. S. Winterflood, managing director of the company, said that several Japanese steel factories were negotiating to import ore and added : " We can expect both prices and quantity to rise this year. The iron ore industry can look forward to a brighter future."

Another boost to the industry is being given by the Perak Iron Mining Co. which, from its activities

near Ipoh, will build up a stockpile for shipment by a new loading system expected to be ready by about the end of March. This is being built at Damar Laut, opposite Lumut. Ore bins are to be erected some three miles from the mouth of the Dindings River and a 1,800-ft. long ramp stretching to mid-stream takes a conveyor-belt which will carry ore to freighters. Fleets of lorries are to take the ore the 66 miles from the mining area to Damar Laut.

Steel Mill for Singapore.—Mr. Lee Kuan Yew, Singapore's Prime Minister, suggested in Jakarta, when he paid a seven-day state visit to Indonesia recently, that a steel mill should be set up in Singapore. It was planned that Indonesian coal and Malayan iron ore would be used. The Indonesian Government expressed "great interest" in the proposed project, which will be explored further when a delegation of Indonesian trade officials visits Singapore in the near future.

Cement from China.—Mr. Sim Lai Hee, manager of Sim Lim Co., Ltd., of Singapore, has said that the firm planned to step up its imports of China's cement this year. It would buy in 1960 about 36,000 tons from the China National Minerals Corporation, for which the firm was sole agent in Singapore. This would be about 10,000 tons more than in 1959.

Oil Storage.—A (Malayan)$3,000,000 ocean terminal for the storage of oil at Port Swettenham is expected to be completed at the end of the year by Caltex Oil (Malaya), Ltd. There will be two 3,000-ft. underground pipelines connecting the terminal to a wharf in the harbour for the pumping of oil directly from tankers.

Following protests from mining, industrial, and commercial organizations, the Federation of Malaya Government has cut its new tax on imported fuel oil. Instead of the 20 cents a gallon it was imposing on imports of diesel oil the Government will levy a tax of 8 cents.

Coal Mining Stops in Malaya.—Operations came to a halt recently at Batu Arang, where Malayan Collieries had run Malaya's only coal mine.

This move was caused by a falling-off in the demand for coal. Malayan Railway had switched from steam to diesel engines.

Coal mining created the town of Batu Arang, which had a population of about 10,000 in its prosperous days. This has gone down to 4,000 persons who are mostly former mine workers now turned squatters.

India.—A total of 720 miles of pipeline is to be laid to carry 2,750,000 tons of crude oil annually into two state-owned refineries from oilfields in Assam. At the same time the Indian Government is getting financial and technical aid from Rumania in building the first refinery—at Noonmati, on the Brahmaputra River, while Russian technicians are to help set up the second refinery—at Barauni on the plains of Bihar.

A new company, Oil India, Ltd., has been established by the Indian Government to extract the Assam oil in partnership with the British-owned Burmah Oil Company. Burmah Oil is providing two-thirds of the capital and will build the 720 miles of pipeline. The Indian Government is providing one-third of the capital and has veto powers on the board. The first 260 miles is expected to be ready by 1961 to bring 750,000 tons of crude oil each year to the Noonmati refinery.

Mining Research.—Under the Colombo Plan the services of Dr. J. W. Whitaker have been made available to the Council of Scientific and Industrial Research, New Delhi. Arrangements were made for him to advise the council on the setting up of a central mining research station at Dhanbad, Bihar, on the creation of facilities for petroleum research and the development of oil resources, and on mining research generally.

SOUTHERN AFRICA

February 27.

Uranium.—Representatives of the Combined Development Agency (the United States and British authority for the purchase of South African uranium oxide) are at present reviewing in Pretoria with the S.A. Atomic Energy Board the uranium producing programme of the gold mines in line with the periodic consultations that characterize relations. It is understood that conditions expected to prevail when the contracts end in the 1963–66 period are also being discussed. Recently company comments indicated that stretching out the contracts to 1970 had been studied but that individual cases presented difficulties. Doubtless these matters are also being discussed in Pretoria. Unofficial expectations are that the contracts will not be renewed when they expire. The present consultation falls in the pre-Summit period and decisions may therefore take account of the alternatives of success or failure of that conference. Meanwhile the research division of the Atomic Energy Board is proceeding with its programme of nuclear development, which includes testing for more efficient processes of extraction and refining in the country in order to produce an oxide competitive in the post-contract period and possibly to produce uranium metal in South Africa. The research director recently stated that because of the high cost the country was unlikely to attempt production of the atomic bomb.

Railways.—According to a report on the South African Railways for 1959 the General Manager has commented that the year's outstanding feature was an effective advance in the carrying capacity, to the point where the Railways could accept and handle all traffic offering without serious delays. The total tonnage moved in 1958–59—79,722,000, 3·5% higher than in the previous year—is expected to be exceeded in 1959–60. The overall capacity of the Railways to accept and convey traffic is now not only equal to current demands but will also serve to take up any normal increase in demands for some years to come: all the traffic on offer can be accepted and there is a substantial margin of surplus capacity.

Mine Pay.—The Mineworkers' Union is negotiating among its constituent member groups to present to the Chamber of Mines a united demand for a 12½% increase in basic wages. An earlier demand on this basis was rejected by the Chamber on behalf, it is understood, of the gold-mine members and on the grounds that the demand should be a matter for negotiation on a wider basis. The present issue may be a routine presentation of a claim which is periodically on the agenda of discussions between the Chamber and representatives of the unions.

Drill at Work at Clydesdale North.

Clydesdale North Disaster.—The accompanying photograph shows the Joy-Sullivan drill borrowed from the Thabazimbi iron-ore quarries of the S.A. Iron and Steel Industrial Corporation and used in an endeavour to reach the collapsed area and help the men entombed. Rotary tri-cone bits were used from January 24 onwards but progress through a thick dolerite sill and iron-ore seams was slow. After reducing the bit diameter from 13½ in. to 9½ in. break-through occurred at about 500 ft. depth into flooded workings on February 4. As was the case through the two diamond-drill holes put down no sign of life was detected. All the indications are, it is feared, of flooded and severely-disturbed workings over an area of several square miles.

Diamonds.—Both De Beers Consolidated and General Electric of the United States have filed applications in South Africa and other countries for patent rights over processes of synthesizing diamond grit. The De Beers company made a provisional application in November, 1958, and another application in October, 1959, at the South African Patents Office and in the United Kingdom filed an application in November, 1959. General Electric filed their South African applications in September, 1959, and December, 1959. In Britain, under reciprocity and by direct application, General Electric can claim two dates, April, 1957, and December, 1958. No litigation in support of any of the above applications has yet been reported.

The Diamond Research Laboratory in Johannesburg—operated jointly by the major diamond interests through De Beers Consolidated Mines—has installed a Philips cascade electron accelerator-generator for altering certain physical characteristics of diamonds—such as, colour, surface structure, hardness, and electrical conductivity—to extend fundamental research into the characteristics of diamonds and to increase their applications in science and industry. The natural blue diamond has been found to act as a rectifier unimpaired by wide fluctuations of temperature but with its resistance sensitive to minute changes of temperature. Some diamonds also function as radioactive counters. The new equipment, recently commissioned, will facilitate extended and intensified research into characteristics of various changes in diamonds effected by high-speed electrons and/or gamma rays. It is capable of continuous operations over any desired periods.

The Precious Stones Amendment Bill, which aims at encouraging consolidation and expansion of diamond exploration and production in South Africa, is in its final stages of debate in the Union Assembly.

Light-Weight Cage.—More resistant to corrosion by water and rust-resistant, lighter, and therefore having greater carrying capacity, a three-deck man-cage has been installed by Randfontein Estates Gold Mining. Fabricated mainly from aluminium and a minimum of steel, this installation in one of its shafts replaces a double-deck steel unit without modification to the hoisting equipment. The aluminium sections were riveted.

Trained Men.—Points made at the recent annual meeting of the Association of Mine Managers included : Avoidance of wasting promising young men through incorrect assessment of their value ; the importance of assigning men to suitable work and of training in and for their particular aptitudes and qualifications ; improved training at the schools ; closer liaison between mine managements and technical colleges, with emphasis on apprenticeship training ; greater calls for specialization in the industry where technicians in all categories are still required, and the shortfall in white or European personnel persists while the native labour complement is now fully adequate. Doubtless more competitive conditions can be expected in the future for native labour and the efficient use of labour remains important, while conditions on the mines should be sufficiently attractive.

Union Economy.—Budgetary considerations are now much in the air as the end of the fiscal year is approaching during which most economic sectors of the country function sluggishly. A notable exception has been gold mining, which has again become a major source of Treasury revenue through an increasing number of new mines and to which expectant Treasury eyes will be cast if revenue from other sources shows material reductions below estimates. So far there has been little overt evidence of this. In the 10 months to January 31 the revenue account reflected a credit amount of £275,483,000, against issues of £263,531,000. If the 1959–60 trend shows the usual seasonal pattern—namely, a surge of funds from the general public sector to the Treasury—the end of March should see a considerable surplus. This may present the fiscal authorities with an opportunity of priming the economy by lightening indirect taxation particularly and so improve the quantitative capacity of consumption among the general public. Most of the organized sectors of the economy have been urging relief—especially mining, industry, and commerce.

Pumping.—South African gold mines each day pump from underground about 120,000,000 gal. of water and consume about 160 MW in the process. The cost of this power is about £8,500. In addition to the considerable sums expended on pumps and their installation substantial amounts are spent on providing underground settlers for the removal of a maximum proportion of the suspended solids, while further expenditure is involved in providing mud-pumping equipment to lift the settled solids to surface. On the operating side maintenance and replacement of worn parts, due to abrasion of impellers and the lining of casings, constitute a significant proportion of working costs. To determine the influence of suspended solids on the rate of wear of multi-stage centrifugal pumps divisions of the S.A. Council for Scientific and Industrial Research have been conducting experiments. The experiments are calculated to determine the particle sizes largely responsible for the high rate of wear and included a study of the mechanism of wear and the quantitative influence of such factors as water speed, the surface shape, the grit type, and the materials of fabrication. Radioactivity techniques proved particularly valuable in the most difficult measurement, that of the wear rate, in so far as these techniques allowed continuous measurement of the wear rate and reduced the time necessary to obtain a measureable amount of wear by a factor of about ten. In one particular problem a perspex disc was rotated in a plane parallel to and separated from a fixed plate by a known distance. Suspended sand particles of known size in water were pumped radially out through the clearance between the two plates, the two wearing surfaces of which had been uniformly coated with radioactive iodine. A Geiger-Muller tube in the circulating slurry gave a continuous reading of the increase in radioactive suspensions and therefore of the rate of wear. The radioactive coating consisted of perspex dissolved in chloroform solution of radioactive iodine.

Transvaal.—Western Reefs Exploration and Development has decided to sink a new shaft, No. 4, to open up the northern section of the mine immediately south of the common boundary with the Zandpan lease area. The new shaft, 26 ft. lined diameter, will be sunk to a depth of 6,700 ft., bratticed for both down- and up-cast ventilation, and equipped for transporting men and materials and for hoisting up to 45,000 tons a month of waste rock. Ore from the area will be trammed on a high-speed transfer-level haulage 12,500 ft. to the No. 3 shaft on the eastern boundary. The new shaft is to be sunk primarily to facilitate exploitation of the Vaal Reef horizon. The indications are, therefore, that development northwards on this horizon from the joint No. 3 shaft has yielded results of a sufficiently encouraging nature to justify the capital expenditure of £2,900,000 on the new project.

Orange Free State.—Faulting, water, and probably gas occurrences relative to available ventilation and pumping capacity from existing facilities have held back any rapid development of Elsburg Reefs from the more advanced of the two twin haulages driven from the Loraine into the Riebeeck section of Loraine Gold Mines. Only a limited amount of stoping of Elsburg ore has so far been effected from the other haulage in the extreme south-western zone of the Loraine section. This has, together with a high rate of waste sorting, about 20%, beneficiated the grade slightly. The Riebeeck shaft should be completed to its final depth by about the mid-year and the twin haulage holed through somewhat later, by about the year-end, after which the resulting improved ventilation will facilitate a greater rate of development from several points along the haulage. Ore hoisted up the Riebeeck shaft will be transported by surface line to the Loraine gold plant which has been expanded to a treatment capacity of 82,000–100,000 tons/month, against 75,000 tons treated in January.

There seems little doubt that a mine will be established on the ground held by Western Holdings immediately south of the Vaal Reefs mine. Further results from the area are expected in the immediate future from two of three bore-holes which seem largely complementary in character as far as essential information is concerned. Of greater basic importance would appear to be results to the east, where Freddies Development and Rand Mines are sinking a joint bore-hole. While the depth eastwards of the Vaal Reef is expected to be considerable, it is possible that the synclinal formation from west to east persists southwards and that therefore there may be an upthrow of the reef to reasonably economic depth south of the Vaal River.

President Steyn expects to have its No. 3 shaft system in the south-western section completed and commissioned for ore hoisting by the end of 1961—gas and water notwithstanding. In the ventilation component, 20 ft. lined diameter, a new world sinking record of 1,020 ft. was recorded in January. Like the main component the shaft will be sunk to a final depth of about 6,300 ft.

Both the original shafts of Welkom Gold Mining will have been deepened when in the near future No. 2 should reach its final depth of 4,600 ft. This will facilitate the cutting of more stope faces in the deeper levels and their commissioning by about the year-end. Meanwhile additional tonnages for the programme of expansion will be drawn from the No. 3 shaft area in the south-western section.

The sinking of its No. 3 shaft system in the north-eastern section by President Brand is in the final stages. With equipping still to be effected the system should be commissioned by the year-end.

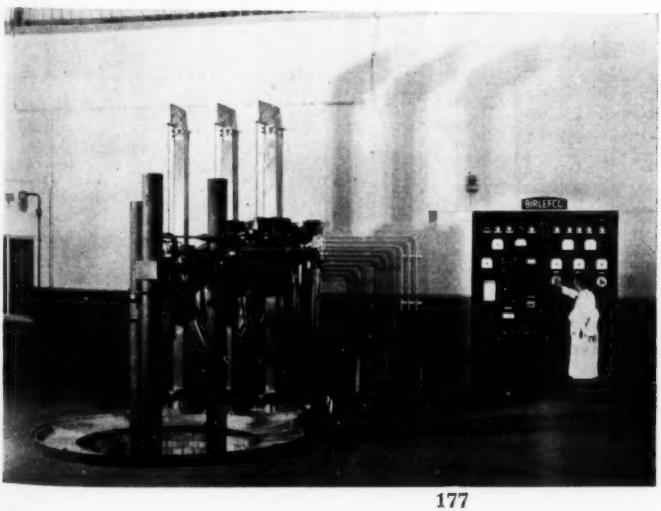
Trade Notes

Brief descriptions of developments of interest to the mining engineer

Pilot Plant for Electric Smelting

Birlec-Efco (Melting), Ltd., of Westgate, Aldridge, Staffs., a company formed by **Birlec, Ltd.,** and **Efco, Ltd.,** for the design and supply of all types of electric melting and smelting furnaces for the ferrous and non-ferrous metal industries, recently gave an opportunity of inspecting a new pilot furnace erected at their works. Now that it is in action there is available in this country for the first time a contract service for electric smelting. Where hydro-electric resources are available, of course, electric smelting can be used economically for the extraction from their ores of nickel, copper, manganese, iron, ferro-alloys, and other materials. Now when the possibility of application is in doubt trial batches of ore can be accepted from any part of the world for test on a miniature scale in the furnace. On completion of the test a detailed report will be submitted, giving recommendations on smelting practice, electrical ratings, and the size of full-scale installation required for a given output. It is believed that the scheme will be specially attractive to mining and metallurgical concerns in the Commonwealth, particularly in Africa and India, where the company and its associates has already installed a total of nine electric smelting furnaces with a combined rating of 36,000 kVA. In Great Britain itself the cost of electric power at present makes electric smelting prohibitive in several of its applications.

The new plant at Aldridge, two views of which are shown here, is of such a size that information can be gained on factors such as power and electrode consumption, operating voltage, percentage recovery, and other relevant data. The furnace itself, with a shell of 8 ft. internal diameter, has a nominal rating of 350 kVA. The furnace is designed to be as versatile as possible, a wide range of voltage tappings having been provided. To determine the effect of rotation the shell can be moved or oscillated in either direction at varying speeds and three tapholes are provided, the levels of which can be altered for slag and metal. It is equipped with holders suitable for 8-in. diameter electrodes, which



Charging Platform.

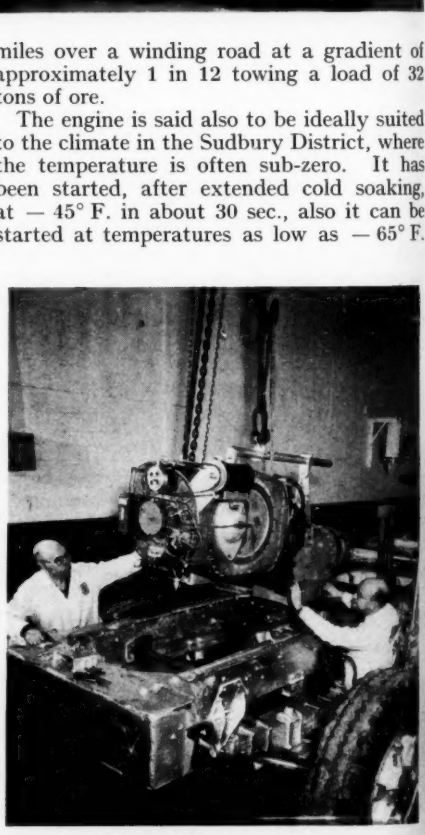
Furnace at Tapping Level.

can be amorphous carbon or graphite, according to the requirements of the tests, and designed so that it can operate as an open-top furnace or the top be closed by the superimposition of a roof with means for fume removal or gas extraction. It is capable of smelting : Calcium carbide ; iron ores ; manganese ores ; producing ferro-silicon and ferro-chrome ; dealing with nickel and copper concentrates, and treating slags. The furnace is available to any company interested in carrying out tests on electro-thermal processes. The installation has laboratory facilities and a competent staff to carry out the development work for which it is intended.

Gas-Turbined Ore Truck

A regenerative gas turbine engine, the GMT-305 Whirlfire, manufactured by the Allison Division of the **General Motors Corporation,** U.S.A., has been delivered to the International Nickel Co. of Canada, Ltd., for installation in a lorry for hauling ore at the open-pit mine in the Sudbury District of Ontario. It is thought that this is the first occasion that a gas turbine engine has been subjected to the severe requirements of ore hauling. The Whirlfire produces 225 h.p. and is a multi-fuel engine with more than double the power of a comparable piston engine per unit volume and it produces approximately 70% more power per pound. The open-pit mine should provide an ideal testing ground, as the truck will have to travel almost two miles over a winding road at a gradient of approximately 1 in 12 towing a load of 32 tons of ore.

The engine is said also to be ideally suited to the climate in the Sudbury District, where the temperature is often sub-zero. It has been started, after extended cold soaking, at — 45° F. in about 30 sec., also it can be started at temperatures as low as — 65° F.

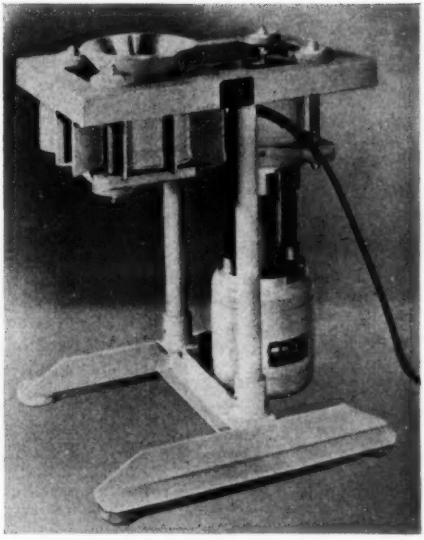


Mounting the Gas Turbine.

Its negligible oil consumption and multi-fuel capabilities make it extremely economical to operate. A definite asset is the fact that optimum fuel economy is realized at full power.

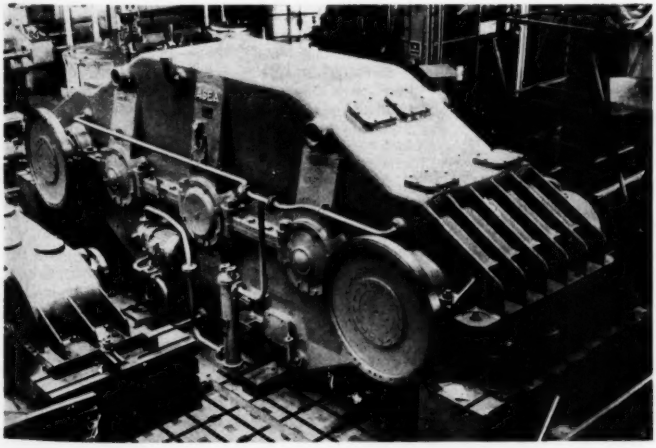
Small Magnetic Separator

Some particulars have recently been made available of a small magnetic separator suitable for the removal of ferrous particles from uranium dioxide by **S. G. Frantz Co., Inc.,** of 31, Kline Avenue, Brunswick Pike, Trenton, New Jersey. The maker's notes state that the small size of the new model 48-V is essential in this case where the critical mass must not be exceeded. With a capacity up to one ton per hour this separator should also find a place in plant and laboratory applications generally. Known as the Ferrofilter dry electromagnetic separator, it consists essentially of a stack of grids (six of 4 in. diameter in this model) which are strongly magnetized by a d.c. coil. The grids have sloping vanes which divide and retard the flow of material. The vanes of alternate grids slope in opposite directions so that the material sifts through the separator on a zig-zag course. An eccentric-weight adjustable vibrator, to keep the material flowing, is securely attached to the separator and driven through a flexible drive so that the motor which hangs below is not subject to the vibration. Cooling fins surround the coil chamber. When the current is turned off and the grids demagnetized, the iron is discharged. Other models are the 68-V with a capacity up to 5 tons per hour and the 88-V up to 25 tons per hour, depending on the fineness, specific gravity, and flowing properties of the material.

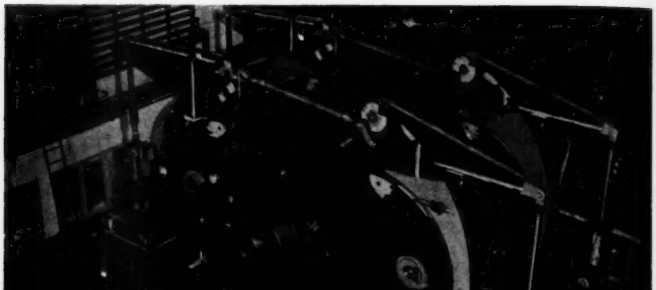


Large Mine Hoist

What is claimed to be the world's largest mine hoist is being delivered to the Soviet Union by **Allmänna Svenska Elektriska AB.**



Double-Reduction Gearbox for 50-ton Hoist.



Winder Assembled for Testing

(ASEA), of Västerås, Sweden. It forms part of a delivery of nine hoisting units, another of the nine being of the same size. The two largest winders were assembled and tested at the ASEA works in Västerås in the autumn of 1959, prior to their delivery to Russia at the beginning of December. The hoist drum of one of these winders weighs 49 metric tons without accessories.

Each winder is designed for double-skip hoisting, individual skips weighing about 40 tons and the net load being 50 tons per skip. The hoisting speed will be 10 m./s. (2,000 ft./min.) and the initial depth of the shaft 900 m. (2,900 ft.). The mechanical equipment is, however, designed for a future depth of 1,300 m. (4,400 ft.) and the hoisting speed will then be increased to 14 m./s. (2,800 ft./min.). For purposes of comparison, the winders at the Kiruna mines have a net load of 20 tons. As far as is known loads heavier than 25 tons have never previously been hoisted at such a high speed anywhere in the world.

In spite of the extremely heavy load the friction-drive pulley has a diameter of only 4 m. (13 ft.). This is because the load is suspended from eight ropes. The maximum number of ropes previously used for friction-drive hoists is four. The motor rating of the hoist is 9,000 h.p., this power being provided by four motors connected to the friction-drive pulley by means of two double-reduction gearboxes, one on each side of the pulley. Each gearbox is driven by two ASEA d.c. motors standing side by side. When at a later stage the speed is increased to 14 m./s. (2,800 ft./min.) the motor rating will have to be increased to 12,000 h.p. The motors are arranged for Leonard drive. There are two 600 r./m. convertors, each consisting of a 6 kV synchronous motor with two d.c. generators.

The winders are to work entirely automatically. In addition to the complete winding equipment ASEA are also supplying ropes, skips, measuring pockets, and the underground transport equipment for conveying the ore from the underground crushers.

Personal

P. K. ALDOUS is home from Chile.

P. D. BENNETTS is now in Northern Rhodesia.

WILLIAM C. BOLENIUS, executive vice-president of American Telephone and Telegraph Company, New York, has been elected a director of the International Nickel Co. of Canada, Ltd.

F. E. BUCH is to cease to be general manager of Mufulira Copper Mines, Ltd., and join the head office in Salisbury.

A. CUSINS is now London manager of Belliss and Morcom, Ltd.

O. T. EVANS has been appointed manager of the new Plant Applications Engineering Department of A.E.I. Heavy Plant Division, with headquarters at Rugby.

R. A. GORGES has been appointed Principal of the Camborne School of Metalliferous Mining. Mr. Gorges is a B.Sc. of the University of Cape Town, as well as of Witwatersrand University, and he holds a mine manager's certificate of South Africa and an advanced ventilation certificate of the Transvaal and O.F.S. Chamber of Mines. He succeeds Mr. G. A. WHITWORTH, who is retiring.

W. P. HORNE is home from Kenya.

ROBERT J. WESTHUIZEN plans to leave Peru in the near future.

N. M. KENNY, general manager of Roan Antelope Copper Mines, Ltd., is to be general manager of Mufulira Copper Mines, Ltd.

H. P. E. LEHNER is returning from Kenya.

D. T. LEWIS has retired from the board of the Pahang Consolidated Co., Ltd., after being associated with the company since its earliest years and a director since 1927.

ROBERT FRANKLIN MEHL, Head of the Department of Metallurgical Engineering, Carnegie Institute of Technology, Pittsburgh, has been awarded the Institute of Metals (Platinum) Medal for 1960 in recognition of his outstanding contributions to the science of metals and to metallurgical education.

A. J. MICHELL is now with the Ministry of Power as H.M. Inspector of Quarries in the North-Eastern Area.

BEN H. PARKER, president of the Colorado School of Mines Board of Trustees, has been elected president of the American Association of Petroleum Geologists.

NORMAN JAMES PETCH, William Cochrane Professor of Metallurgy, King's College, University of Durham, has been awarded the Rosenhain Medal of the Institute of Metals for 1960 in recognition of his outstanding contributions in the field of physical metallurgy.

NORMAN READMAN, managing director of the Consolidated Pneumatic Tool Co., Ltd., has been elected to the board of directors of the New York parent company.

J. L. REID, manager of Roan Antelope Copper Mines, Ltd., is to be general manager, while H. J. WEDGWOOD, assistant manager of Roan Antelope, is to be manager.

G. A. SCHNELLMANN has returned from a visit to India.

C. W. TACHIE-MENSON, C.B.E., has been appointed a director of Ghana Main Reef, Ltd.

JACK THOMSON is to cease to be head of the Rhodesian Department of Selection Trust, Ltd., in London and to become resident director in Lusaka, Northern Rhodesia.

P. W. WATSON is returning from Ghana.

PETER WRIGHTSON, managing director of Head Wrightson and Co., Ltd., since 1955, has been appointed vice-chairman and managing director.

KENNETH STUART JONES, who died on December 31, aged 75, was at the Royal School of Mines from 1903 to 1906. A metallurgical chemist, he had for most of his career been engaged in the chemical engineering industry in this country. He was a Fellow of the Chemical Society and an Associate Member of the Institution of Mechanical Engineers.

WILLIAM FRANCIS PORTER MCLINTOCK, Director of the Geological Survey and Museum of Practical Geology from 1945 to 1950, died on February 21, aged 73. Curator of the Museum from 1921 onwards, Dr. McLintock, together with the then director, Sir JOHN S. FLETT, was largely responsible for the move from Jermyn Street to South Kensington, where the new headquarters was opened by the late King George VI, then Duke of York, in July, 1935. In the years of World War II, when the museum was dismantled, Dr. McLintock became deputy director of the Survey's Atomic Energy Division. He was appointed C.B. in 1950, following his retirement.

BRIAN LLEWELLYN, who died suddenly at his home on February 22, was trained at the Royal School of Mines from 1913 to 1914 and 1919 to 1921, serving throughout the first World War in the Royal Engineers and gaining the M.C. and bar. After graduating from the School of Mines in 1921 Major Llewellyn was professionally engaged in many parts of the world, but in 1939 he returned to the Forces, again with the Royal Engineers, only to be released in 1942 to become consulting engineer to the Non-Ferrous Mineral Development Control. At the conclusion of hostilities in 1945 Major Llewellyn became connected particularly with companies engaged in the re-opening of abandoned tin and copper mines in Cornwall, for a time acting as manager of New Consols. A B.Sc. of London University, he was also a Member of the Institution of Mining and Metallurgy.

Metal Markets

During February[1]

Copper.—The market for copper is still under the influence of the American strikes, although all but that at Phelps Dodge's Laurel Hill refinery had been resolved by the end of February. The market is thus being influenced now by a shortage of metal resulting from the prolonged shut-down.[2] When the various settlements were announced at the end of January and the beginning of February spot prices eased considerably, but within a matter of days they were back to something like their previous peak levels and so it was throughout the whole of the first half of the month. Spot supplies were—and still are—short almost everywhere and there was, and is, little or no sign of any immediate easing of the situation. On the other hand everything points to a surplus of supplies later in the year, but as first one market factor and then another highlighted either the nearby or future position so the spot price rose and fell.

Demand for copper has certainly been brisk in the past few weeks and not only from European and United States consumers. China came into the picture early in the month with an order for wire rods from the United Kingdom. Then European buyers began asking for quantities over and above their period contracts and Japan, too, emerged as a strong buyer of spot metal. At the same time India is beginning to make itself felt as a market factor and there is a possibility that other countries in a similar position as regards industrial and economic development may also wish to purchase material in the coming months. That the overall future supply position will be distinctly easy, if nothing else, however, has been further underlined recently in the United States where smelters have cut their scrap buying prices to levels which indicate a bearish attitude to forward rates for primary metal.

U.K. copper consumption in December amounted to 59,246 tons, of which 44,753 tons was electro. Primary refined metal produced in this country in the same month totalled 7,800 tons and secondary refined produced amounted to 9,134 tons. Stocks of blister copper on December 31 were slightly higher than in November at 11,049 tons. Stocks of refined were again down, amounting to 43,956 tons, compared with 50,312 tons on November 30.

[1] Recent prices, pp. 144, 184.
[2] See Table, p. 184.

Tin.—After a period of marked stability throughout most of February the tin market assumed a more depressed appearance in the last week of the month and the volume of buying declined.[1] Consumption remains quite good, however, with the U.S. tinplate industry maintaining a particularly high rate of activity, but some observers think that it may finally prove that present supplies are rather too plentiful to be fully absorbed. A good deal hinges in the future on decisions taken at the next quarterly meeting of the Tin Council and at the major meeting in May, when a future Tin Agreement will be discussed.

Tin consumption in this country in December last totalled 1,977 tons. Production of new metal amounted to 2,858 tons and stocks on December 31 rose again—this time to 11,528 tons compared with 10,545 tons at the end of November.

Lead.—The official communiqué at the end of the Lead and Zinc Study Group meeting in Geneva confirmed trade forecasts that the restrictions on supplies were to be continued, at least for the next few months, but some disappointment was caused by estimates of the relationship between consumption and supplies during the rest of the year. In consequence of both these bearish factors the market took on an easier tone from the outset of the month and prices[1] were restrained for some time, despite the fact that many observers were quick to point out that barter deals and the like would almost certainly take care of quite a proportion of the supply surplus in the coming months.

On the other hand, consumer demand has been quite well maintained in the past few weeks and in the first half of the month it was certainly sufficient to absorb the metal on offer, if nothing else. Indeed, by the end of the month there was a noticeable tightening in the supply situation with regard to nearby metal, a factor which caused a rise in the London Metal Exchange current month price and a widening in the backwardation as the end-month settlement approached.

This change, however, is still no more than largely technical and the overall position is, of course, still one of fully adequate supplies. At the same time U.K. imports in the first month of this year were noticeably smaller than in January, 1959. At 13,062 long tons (compared with 19,620 tons a year ago) they were also on the low side compared with last year's monthly average of 15,053 tons. As long as demand holds up prices could continue to improve beyond their present levels and the continuation of the supply restrictions should ensure that this is true on a global basis as well as a domestic one. On the other hand, the likelihood of further additions to producers' stocks while these restrictions are being maintained casts something of a shadow over the long-term prospects—a shadow that must surely come in for considerable attention at some future date.

U.K. consumption in December amounted to 31,772 tons. Production of English refined lead in the same month totalled 7,881 tons and stocks at the end of the month stood at 48,035 tons compared with 46,984 tons on November 30.

Zinc.—Despite the fact that the Lead and Zinc Study Group reported that the statistical outlook was good—hence its recommending of the lifting of last year's voluntary supply restrictions by producers—the zinc market took on an easier tone at the beginning of February than for some months before.[1] The British Government's disclosure of the fact that it intended to dispose of about 54,000 tons of stockpile material had a bearish effect on February prices, as most estimates had put the quantity available for disposal at a rather lower figure. At the beginning of March, however, the official announcement made it clear that the release would be phased over four years and that only a limited quantity would be of g.o.b. metal—the grade which is likely to have most effect on market quotations. There is no doubt that these factors had the effect of completely eliminating any price reaction at the time of the official announcement.

World consumption was maintained at a good level during the month, but there was certainly no consumer worry as to future supplies except in Japan where, for the first time for several years, the Government authorized the allocation of foreign exchange for the purchase of electrolytic and refined metal from outside sources. Japan has been experiencing a squeeze on supplies for some little time past, however, and the situation has now been aggravated by labour troubles, culminating in a threat of a mass walk-out of non-ferrous metal workers early in March.

December consumption of zinc in the United Kingdom amounted to 30,829 tons. Production was 7,024 and stocks on December 31 totalled 37,162 tons (35,460 tons at the end of November).

Aluminium.—The recent dull patch in the United Kingdom market for "cheap" virgin aluminium from Russian and East European sources seems to be clearing and small quantities are again making their appearance at a discount of £4 or more a ton under the standard price of £186. Since the final quarter of last year suppliers of this cheap metal have been keeping very much in the background so as not to disrupt the price structure. However, with the price of scrap metal rising continuously under the stimulus of an insatiable demand, secondary ingot makers—the main consumers—have recently been finding themselves faced with the possibility that before much longer the dearest grades might cost the same as virgin ingot. Thus they have been digging in their heels to some extent, threatening, in fact, to incorporate a proportion of virgin metal in their ingots and thereby relieve some of the pressure on supplies of scrap. Indeed they have had to do this in the past two or three weeks, although it does not appear so far to have had any noticeable steadying effect on scrap prices. What their move has done, however, has been to bring out the small quantities of East European metal already noted and it is conceivable that further offerings may follow if the secondary ingot makers maintain their present call for virgin metal for any length of time.

Total U.K. imports of unwrought, unalloyed aluminium from the U.S.S.R. in 1959, as revealed in figures released in February, amounted to 15,351 long tons, an annual rate of imports slightly in excess of that established in the 1958 Anglo-Russian agreement which expired on September 30, 1959. As it happened Russian shipments to this country in the full 12 months covered by the agreement amounted to little more than two-thirds of the 15,000-tons maximum on which no anti-dumping duty was to be charged by the British Government, but since

[1] See Table, p. 184.

[1] See Table, p. 184.

then the trade has been watching the situation anxiously. It now appears that the monthly rate of shipments in the October–December quarter was constant, whereas previously Russia's aluminium exports have always been seasonal, decreasing with the onset of winter and increasing again in the spring. With this in mind a number of observers are now wondering how the total level of arrivals by the end of this year will compare with that of 1959.

Iron and Steel.—Brisk conditions continue to prevail in the U.K. iron and steel industry. Demand for most products has been maintained at a high level and the industry is very busy meeting consumers' requirements. In January raw steel production in this country set up a new record, reaching an average weekly rate of 471,400 tons, as compared with the previous peak of 458,600 tons a week last November. The January pig-iron output was also a new record, rising to 297,500 tons a week from the previous best of 285,500 tons established in October, 1957.

Despite the record rate of production there is tightness in supplies of some products. Sheets, in fact, are very tight indeed and allocations to some consumers have been reduced, thus making imports still very necessary. Imports of sheet this year are expected to amount to about 200,000 tons, as compared with over 259,000 tons in 1959.

In addition to the heavy call for sheets there is a persistent demand for other light steel products (strip, tinplate, small bars and sections, wire, wire rods, and alloy and stainless steels), while the heavy section and plate mills are also enjoying better conditions. The heavy steel trade, however, is bedevilled by the restricted flow of orders from the coal mines, the railways, and the shipyards. Whereas plate and section rollers are able to offset these losses to some extent with orders from other consumers, which have, incidentally, been at encouraging levels lately, the makers of colliery equipment and railway materials are not so fortunate and are finding conditions quite difficult at the present time.

The steel industry has been one of the few major industries in this country to follow the Chancellor of the Exchequer's repeated pleas to cut prices. The Iron and Steel Board reduced prices of hematite pig-iron by 15s. a ton and amended the basic iron extras on February 8. The Board also cut heavy steel plates by 10s. a ton, heavy sections and joists by £1 a ton, and tinplate (according to specification) by an average of £1 a ton. This was the third in a series of reductions in home trade prices and makes, with the previous changes in March, 1958, and June, 1959, an overall reduction of 2½% to 3% in the general level of steel prices. The U.K. export prices of plates and heavy sections were brought into line with the home trade prices on February 17.

Iron Ore.—With growing signs that scrap supplies are becoming tighter steelmakers are having to use bigger tonnages of basic iron and as a result production has reached record dimensions. Thus far this has been achieved by working existing blast-furnaces to capacity and the greater use of sinter in furnace charges. However, more blast-furnaces are expected to be brought back into service and this will mean that additional tonnages of iron ore will be required. Arrivals of foreign ore continue on an impressive scale; in January they increased to 1,353,053 tons, from 1,289,504 tons in December and 1,016,376 tons in January a year ago.

Antimony.—The antimony market has taken on a largely featureless appearance in the past few weeks, although communist China is reported to have stepped up its shipments to Canada, thus taking advantage of the shortage of European material in that country resulting from the prolonged strikes at Belgian producers' plants. Material said to be of comparable quality to European 99·6% is now selling there at 19½ cents a lb., which is about 6 cents a lb. under the New York price for imported material. English regulus 99·6% is still quoted on the home market at £197 10s. a ton delivered and 99% material at £190.

Arsenic.—The market was again featureless in February. Arsenic metal continues to be quoted at £400 a ton, while arsenic trioxide, ex stock, remains priced at £40 to £45 a ton.

Bismuth.—There were no new features as regards trading in bismuth during February and the nominal price for 1-ton lots, ex warehouse, remains at 16s. a lb.

Cobalt.—A certain tightness in supplies of cobalt metal, which made itself felt last year when a large quantity was removed from the market due to fire in a United States warehouse, now seems to have eased and more liberal quantities are available. Towards the end of February it was announced that prices would be reduced with effect from March 1. The U.K. open-market price, for example, has been reduced from 14s. a lb. delivered to 12s. The U.K. contract price is now 10s. 9d. a lb. delivered against 12s. 6d. previously.

Cadmium.—The recent strength of the world cadmium market was maintained throughout February. Belgian prices were raised early in the month to a United Kingdom equivalent of 10s. 3d. a lb. and then again to 10s. 5d. to 10s. 6d. a lb. U.K. and Empire refined, however, remained quoted in this country at 10s. a lb. for 1-cwt. lots until the end of the month, although with consumption running at a good level throughout its price seemed likely to be raised at almost any time.

Chromium.—Chromium metal was featureless from a market point of view in February and prices were again unaltered in the range 6s. 11d. to 7s. 4d. a lb.

Tantalum.—Tantalum ore prices in the United Kingdom were again unchanged, with 60% ore quoted once more at 650s. to 700s. a unit c.i.f. In the United States the Fansteel Metallurgical Corporation cut its prices for powder, oxide, and carbide by up to 25%, revising its quotation for powder in 5,000-lb. quantities to $30 a lb., as compared with $40 previously. At the same time the price for 100-lb. quantities was reduced from $40 a lb. to $35.

Platinum.—U.K. and Empire refined platinum was selling steadily throughout the month at £30 5s. a troy oz. and imported metal at prices varying from £28 10s. to £29. As reported last month both these values were established towards the end of January, when the market became firmer.

Iridium.—February was another featureless month so far as trading in iridium was concerned and the price of sponge and powder per troy oz. was again quoted at a nominal £24 to £26 15s.

Palladium.—After its show of strength in January the palladium market settled down to a quiet, featureless spell during February with the price per troy oz. constant at £9 7s. 6d. throughout the month.

Osmium.—The price of osmium is again unaltered at £23 to £32 5s. per troy oz.

Tellurium.—Like the price of palladium that of tellurium has settled down at the new levels established in January. Lump and powder 99% to 99·5% is currently selling at 21s. 6d. to 25s. a lb., while tellurium sticks are again quoted at 30s. a lb.

Tungsten.—The price for Contract B ore advanced by 1s. a unit to 156s. to 161s. c.i.f. Europe midway through the month as inquiry from both Continental and United Kingdom consumers picked up from the rather quieter level prevailing earlier. On the whole, however, the month was one of fluctuating demand to meet which there was always sufficient material available from merchants, to say nothing of the U.K. Government quota of about 80 tons.

Nickel.—Japanese nickel producers caused something of a surprise in February when they expressed some nervousness over their future ore supplies. The recent trade liberalization moves by the Japanese Government will enable nickel ore to be imported without recourse to the ore buying cartel which has always acted in the past and this has caused fears that direct buying by consumers will step up competition in the international market and bring about undue price fluctuations.

The recent course of developments in New Caledonia suggests that France may soon be able to dispense with imports of nickel from other sources. The Canadian Falconbridge organization has improved its volume of sales to the United States in recent months and, according to latest reports, that country now takes about half of the company's mine output. Prices have remained very much the same in spite of these and other developments in the last few weeks and refined nickel is still quoted in this country at £600 a ton delivered, for quantities of 1 ton and over.

Chrome Ore.—The biggest development in the chrome-ore market in February was the announcement that the Showa Denko company in Japan had contracted with the U.S.S.R. for some 20,000 tons of 48% ore at a price reported to be in the region of $34 a ton c.i.f. Japan. This, which is Japan's largest order from Russia to date (although in January she also bought a considerable quantity, as reported last month) will possibly have some far-reaching effects on the market as a whole. For the present, however, it is more likely to worry Philippine producers than those of Rhodesia, Turkey, and elsewhere. European consumption of metallurgical-grade ore is now running at a reasonably satisfactory level, but the hoped-for increase in the volume of new orders is not yet in evidence. Prices, too, show no signs of increasing and Rhodesian and Turkish metallurgical-grade ore is again quoted at £15 15s. c.i.f. and a nominal $35·50 f.o.b., according to the respective origins.

Molybdenite.—Molybdenum ore quotations were again unchanged in February with American Metal Climax material fetching 8s. 11d. a lb. of Mo contained f.o.b. mine. Ore from other sources was again quoted at 9s. 3½d. a lb. c.i.f.

Manganese Ore.—The market for manganese ore remains in a depressed state and the European price for 46% to 48% ore is still given nominally as 68d. to 73d. The United States-Indian barter deal reported on last month has assumed a somewhat new complexion during February and it now appears that the agreement provides for only ferro-manganese to be delivered to the Commodity Credit Corporation and not ferro-manganese and manganese ore, as arranged earlier. A significant proportion of the amount provided for will not be made in India, however. Instead it will be converted in Japan and elsewhere, provided that appropriate quantities of ore are shipped from India to the countries concerned by June 1 this year.

Tin, Copper, Lead, and Zinc Prices

Tin, minimum, 99·75%; Copper, electro; Lead, minimum 99·75%; and Zinc, minimum 98%, per ton.

Date	Tin		Copper		Lead		Zinc	
	Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Feb. 11	793 0	790 5	269 10	245 17½	71 18¾	72 6¼	89 6¼	89 18¾
12	793 0	790 15	271 10	246 17½	72 8¾	72 17½	89 8¾	89 13¾
15	794 0	791 15	272 15	249 15	73 18¾	74 3¾	89 7½	89 17½
16	794 0	791 15	266 10	247 5	73 12½	73 13¾	88 17½	89 2½
17	794 10	794 0	266 15	248 7½	73 18¾	74 1¼	88 1¼	88 7½
18	794 10	794 0	269 5	249 7½	74 13¾	74 13¾	86 17½	87 7½
19	794 0	792 15	266 5	248 5	75 3¾	74 17½	87 0	87 7½
22	793 0	791 15	251 0	243 17½	75 13¾	74 18¾	87 8¾	87 11¼
23	793 0	791 15	250 10	243 5	75 11¼	74 16¼	88 1¼	88 1¼
24	791 10	789 5	252 10	240 17½	75 1¼	74 6¼	87 11½	87 13¾
25	790 0	788 5	253 15	241 17½	74 8¾	73 17½	87 13¾	87 13¾
26	790 0	788 15	256 5	242 7½	75 7½	74 7½	87 6¼	87 8¾
29	789 10	788 0	257 15	242 12½	75 1¼	74 8¾	87 2½	87 8¾
Mar. 1	790 0	789 10	252 5	239 12½	74 18¾	74 3¾	87 12½	87 8¾
2	789 10	788 5	256 15	239 7½	75 3¾	74 6¼	87 8¾	87 8¾
3	785 0	784 5	259 15	241 5	75 16¼	74 13¾	87 18¾	87 16¼
4	784 10	783 15	257 10	239 5	75 12½	74 13¾	87 13¾	87 8¾
7	783 10	783 5	253 10	236 7½	75 7½	74 7½	87 13¾	87 3¾
8	783 10	783 0	251 5	235 17½	75 0	74 3¾	88 2½	87 2½
9	783 10	783 5	252 5	237 10	75 12½	74 11¼	88 17½	87 8¾
10	—	—	—	—	—	—	—	—

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	Jan.		Feb.	
	Treated Tons	Yield Oz.†	Treated Tons	Yield Oz.*
Blyvooruitzicht	128,000	83,825	124,000	81,322
Brakpan	142,000	17,268	134,000	16,474
Buffelsfontein‡	145,000	56,944	143,000	56,188
City Deep	100,000	22,897	100,000	22,983
Cons. Main Reef	82,000	15,458	73,000	14,158
Crown Mines	213,000	34,830	196,000	32,698
Daggafontein	230,000	46,351	231,000	46,457
Doornfontein‡	96,000	38,890	94,000	38,413
D'rb'n Roodeport Deep	196,000	35,580	179,000	32,932
East Champ D'Or‡	12,000	306	12,000	280
East Daggafontein	102,000	17,290	104,000	17,441
East Geduld	134,000	39,671	128,000	37,760
East Rand P.M.	218,000	55,479	206,000	53,706
Eastern Transvaal Consol	18,700	6,189	19,000	6,219
Ellaton‡	29,000	6,890	28,000	6,652
Freddies Consol.	59,000	13,279	58,000	13,385
Free State Geduld	95,000	81,941	94,000	81,076
Geduld	72,000	13,949	72,000	13,143
Government G.M. Areas‡	54,000	10,856	51,000	10,350
Grootvlei Proprietary	215,000	44,962	210,000	43,891
Harmony Gold Mining	150,000	60,163	142,000	57,019
Hartebeestfontein‡	100,000	47,000	100,000	47,250
Libanon	112,000	26,391	112,000	26,647
Loraine	75,000	15,563	76,000	16,150
Luipaards Vlei‡	117,000	13,102	115,000	12,923
Marievale Consolidated	99,000	24,181	96,000	23,616
Merriespruit‡	—	—	—	—
Modderfontein East	131,000	12,983	131,000	12,710
New Kleinfontein	83,000	10,123	74,000	9,701
New Klerksdorp‡	11,000	1,277	10,700	1,170
President Brand	115,000	94,180	115,000	93,276
President Steyn	102,000	40,166	100,000	38,805
Rand Leases	175,000	26,512	179,000	27,298
Randfontein‡	183,000	12,096	181,000	12,563
Rietfontein Consolid't'd.	16,000	4,245	16,000	4,202
Robinson Deep	50,000	9,637	44,000	8,940
Rose Deep	27,000	4,464	26,000	4,406
St. Helena Gold Mines	155,000	51,150	155,000	51,928
Simmer and Jack	77,000	13,840	79,000	13,123
S. African Land and Ex.	93,000	19,390	94,000	19,615
S. Roodepoort M.R.	30,000	7,236	29,000	6,931
Spaarwater Gold	10,900	3,395	10,600	3,301
Springs	105,000	14,414	104,000	14,406
Stilfontein Gold Mining‡	160,000	72,080	147,000	66,150
Sub Nigel	66,500	15,265	64,000	15,030
Transvaal G.M. Estates	7,600	2,030	5,700	1,954
Vaal Reefs‡	94,000	42,300	94,000	42,300
Van Dyk Consolidated	69,000	12,035	70,000	11,886
Venterspost Gold	129,000	32,582	124,000	31,403
Village Main Reef	30,500	4,666	32,100	4,910
Virginia O.F.S.‡	133,000	30,058	134,000	30,284
Vlakfontein	51,000	18,220	50,000	17,989
Vogelstruisbult‡	88,000	18,930	86,000	18,284
Welkom Gold Mining	98,000	30,445	98,000	30,963
West Driefontein‡	115,000	105,241	118,000	108,514
West Rand Consol.‡	203,000	19,826	199,000	19,302
Western Holdings	147,000	97,755	148,000	98,790
Western Reefs	134,500	37,660	135,000	37,935
Winkelhaak	80,000	24,401	79,000	24,214
Witwatersrand Nigel	19,000	4,395	18,500	4,288

† 250s. 4d. * 249s. 10d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
Dec., 1958	16,540,150	67 7	47 10	19 9	25,934,441
Jan., 1959	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.	16,743,500	68 0	45 4	22 8	25,934,881
April	—	—	—	—	—
May	—	—	—	—	—
June	17,845,100	69 1	45 2	23 11	28,473,191
July	—	—	—	—	—
August	—	—	—	—	—
Sept.	18,214,200	70 5	45 2	25 3	30,140,529
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	17,670,000	72 2	45 10	26 4	30,559,937

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
February, 1959	1,472,090	34,618	1,506,708
March	1,561,196	32,271	1,593,467
April	1,616,891	36,815	1,653,706
May	1,641,990	30,371	1,672,361
June	1,665,503	34,465	1,699,968
July	1,700,968	48,414	1,749,382
August	1,699,098	36,052	1,735,150
September	1,701,485	36,567	1,738,052
October	1,718,916	33,576	1,752,492
November	1,688,379	34,903	1,723,282
December	1,662,043	31,309	1,693,352
January, 1960	1,701,110	34,651	1,735,761

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
May 31, 1959	385,278	33,186	418,464
June 30	383,903	33,146	417,049
July 31	381,190	33,295	414,485
August 31	377,257	32,994	410,251
September 30	371,813	32,903	404,716
October 31	365,833	32,567	398,400
November 30	358,746	32,067	390,813
December 31	354,058	31,903	386,021
January 31, 1960	372,254	31,993	404,247

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To Jan. 30.		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	35,775	1,644	1,990
Electrolytic Zinc	13,236	738	3,850
Lake George	20,873	1,574	3,080
Mount Isa Mines**	63,548	3,990†	3,443
New Broken Hill	—	—	—
North Broken Hill	—	—	—
Zinc Corp.	—	—	—
Rhodesia Broken Hill*	—	—	—

* 3 Mths. ** Copper 3,155 tons. † Metal.

RHODESIAN GOLD OUTPUTS

	January		February	
	Tons	Oz.	Tons	Oz.
Cam and Motor	32,775	—	31,867	—
Falcon Mines	20,500	3,904	20,300	3,907
Globe and Phœnix	5,900	3,208	—	—
Motapa Gold Mining	—	—	—	—
Mazoe	3,274	—	2,833	—
Coronation Syndicate	12,313	—	12,252	—
Phœnix Prince*	—	—	—	—

* 3 Months.

WEST AFRICAN GOLD OUTPUTS

	January		February	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	62,351	12,604	—	—
Ariston Gold Mines	40,190	13,032	—	—
Ashanti Goldfields	35,500	29,050	35,500	29,550
Bibiani	30,000	7,000	32,000	6,900
Bremang	—	4,314	—	—
Ghana Main Reef	12,077	4,307	12,700	4,121
Konongo	6,810	3,498	7,000	3,565
Lyndhurst	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1958		1959	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,305	46,553	46,489	18,077
February	43,591	21,313	43,366	19,806
March	43,830	8,179	48,397	17,394
April	46,587	22,573	—	—
May	46,015	19,937	46,423	46,280
June	46,453	20,105	49,995	31,386
July	44,244	19,170	46,512	32,734
August	47,484	20,549	38,727	29,178
September	48,295	21,141	56,760	33,837
October	46,311	6,342	48,528	32,314
November	47,994	16,435	47,916	31,092
December	48,888	30,724	—	—

WESTRALIAN GOLD PRODUCTION

	1958	1959	1960
	Oz.	Oz.	Oz.
January	66,562	63,924	64,794
February	65,965	65,035	—
March	65,420	65,408	—
April	60,855	62,686	—
May	64,196	64,184	—
June	67,929	74,590	—
July	81,106	78,974	—
August	68,610	—	—
September	68,744	—	—
October	70,128	70,427	—
November	67,562	68,858	—
December	120,106	117,474	—
Total	867,187	866,609	—

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To Jan. 5		To Feb. 2	
	Tons	Oz.	Tons	Oz.
Central Norseman	14,262	7,118	14,436	8,639
Gold Mines of Kalgoorlie	41,152	11,440	40,916	11,771
Gt. Boulder Gold Mines*	—	—	—	—
Gt. Western Consolidated	31,611	5,447	34,157	5,600
Lake View and Star*	—	—	—	—
North Kalgurli			28,801	6,346
Sons of Gwalia	15,718	3,327	8,016	1,413
Mount Morgan	—	6,550	—	5,299

* 3 Months

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
September, 1958	771,115	202,708	31,543	7,006,517
October	801,965	209,006	34,914	7,178,218
November	783,065	230,251	35,097	7,842,435
December	787,573	219,351	30,389	7,490,004
January, 1959	799,178	227,656	41,277	7,700,672
February	727,843	227,981	32,976	7,708,523
March	807,952	223,728	33,045	7,616,425
April	776,583	225,027	32,778	7,712,425
May	791,199	227,924	34,006	7,713,970
June	768,725	213,486	31,692	7,178,823
July	774,749	221,814	32,172	7,498,030
August	683,819	191,598	29,141	6,428,545
September	754,208	213,772	34,139	7,116,556
October	794,030	227,192	34,733	7,558,567
November	770,437	227,176	35,262	7,600,949
December	775,803	221,377	40,807	7,388,654

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	Jan.		Feb.	
	Tons.	Oz.	Tons	Oz.
Clutha River	—	312	—	315
Lampa (Peru)†	—	—	—	28,950
New Guinea Goldfields	4,286	1,335	—	—
Yukon Consol.	—	—	—	—

† Oz. Silver : Copper, 83 tons.

AUSTRALIAN BASE-METAL OUTPUTS

Period	Concentrate Production (Long Tons)		
	Zinc	Copper (a)	Lead
1958	263,044	75,047	327,368
Provisional			
1959—January	11,966	7,372	17,350
February	22,657	6,873	29,650
March	18,054	7,856	23,318
April	22,492	8,007	28,785
May	20,091	7,269	28,416
June	20,323	8,596	25,569
July	24,370	7,013	31,654
August	20,803	7,741	25,438
September	22,047	7,800	25,592
October	19,878	8,853	23,892
November	25,307	7,816	32,131

(a) includes Cu content of direct smelting ore.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	Dec.	Jan.	Feb.
Ampat Tin	52	81	80
Austral Amalgamated	—	—	—
Ayer Hitam	353*	—	—
Batu Selangor	—	—	—
Berjuntai	167	182	201
Chenderiang	47½*	—	—
Gopeng Consolidated	270*	—	—
Hongkong Tin	65*	—	—
Idris Hydraulic	41*	—	—
Ipoh	68*	—	—
Jelapang Tin	—	—	—
Kampong Lanjut	98	84	110
Kamunting	102	115	154½
Kent (F.M.S.)	50*	—	—
Kepong	—	—	—
Killinghall	80*	—	—
Kinta Kellas	—	31	33
Kinta Tin Mines	—	—	—
Klang River	—	—	—
Kramat	78	76½	68
Kuala Kampar	68	64	62½
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Lahat Mines	—	—	—
Larut	—	—	—
Lower Perak	142½	166	205
Malayan	741½*	—	—
Malaysiam	—	—	—
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	465½*	—	—
Pengkalen	85*	—	—
Petaling Tin	308*	—	—
Puket	—	—	—
Rahman Hydraulic	—	—	—
Rambutan	204*	—	—
Rantau	57	39½	38
Rawang Concessions	—	—	—
Rawang Tin Fields	—	—	—
Renong	228½*	—	—
Selayang	46*	—	—
Siamese Tin Syndicate (Malaya)	—	25	25
Southern Kinta	298	268	219
Southern Malayan	598½*	—	—
Southern Tronoh	—	—	—
Sungei Besi	219*	—	—
Sungei Kinta	50*	—	—
Sungei Way	—	—	—
Taiping Consolidated	266*	—	—
Tambah	—	—	—
Tanjong	176*	—	—
Tekka	24½*	—	—
Tekka-Taiping	—	—	—
Temoh	9*	—	—
Tongkah Compound	—	—	—
Tongkah Harbour	44½	33½	132
Tronoh	650*	—	—
Ulu Klang	—	—	—

* 3 Months.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	Jan.		Feb.	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines	318	39	286	—
Anglo-Burma Tin *	23	—	—	—
Bangrin	30	—	49	—
Beralt	5	160†	4	178†
Bisichi	47½	30	47½	30
Ex-Lands Nigeria	50	—	41	—
Geevor	60	—	—	—
Gold and Base Metal	70	8	—	—
Jantar Nigeria	17	22	—	—
Jos Tin	12	—	—	—
Kaduna Prospectors	6	—	5	—
Kaduna Syndicate	30	—	25	—
Katu Tin	27	—	27	—
Keffi Tin	—	—	—	—
London Nigerian Mines	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	12	—	—	—
Naraguta Karama	9½	—	9½	—
Naraguta Tin	—	—	—	—
Renong Consolidated	—	—	—	—
Ribon Valley (Nigeria)	26	1	—	—
Siamese Tin Syndicate	52	—	132	—
South Bukeru	—	—	—	—
South Crofty	78	—	73	—
Tavoy Tin	—	—	—	—
Tin Fields of Nigeria	—	—	—	—
United Tin Areas of Nigeria	—	—	—	—

* 3 months. † Wolfram.

SOUTH AFRICAN MINERAL OUTPUT

November, 1959.

Gold	1,721,819 oz.
Silver	177,582 oz.
Diamonds	102,601 carats.*
Coal	3,211,413 tons.
Copper	(*a*) — tons in matte and copper-gold concentrates. (*b*) 5,041 tons of 99·29%.
Tin	tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	15,155 tons.
Chrome Ore	60,398 tons.
Manganese Ore	95,156 tons.
Lead Concs.	20 tons.

* *October, 1959*

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		Dec.	Jan.
Iron Ore	tons	1,289,504	1,353,093
Manganese Ore	,,	25,553	36,066
Iron and Steel	,,	74,321	73,468
Iron Pyrites	,,	7,935	16,500
Copper Metal	,,	35,139	44,383
Tin Ore	,,	6,096	4,365
Tin Metal	,,	503	190
Lead	,,	18,486	13,062
Zinc Ore and Conc.	,,	13,266	5,528
Zinc	,,	16,205	24,715
Tungsten Ores	,,	789	520
Chrome Ore	,,	8,306	6,519
Bauxite	,,	17,562	35,330
Antimony Ore and Concs.	,,	1,220	1,218
Titanium Ore	,,	5,463	20,715
Nickel Ore	,,	—	—
Tantalite/Columbite	,,	66	39
Sulphur	,,	41,382	41,206
Barytes	,,	2,955	2,081
Asbestos	,,	13,357	9,386
Magnesite	,,	2,982	5,684
Mica	,,	358	503
Graphite	,,	535	420
Mineral Phosphates	,,	62,016	154,337
Molybdenum Ore	,,	544	233
Nickel	cwt.	84,614	28,145
Aluminium	,,	552,234	580,656
Mercury	lb.	156,015	98,794
Bismuth	,,	43,183	142,204
Cadmium	,,	267,879	282,534
Cobalt and Cobalt Alloys	,,	229,560	409,710
Selenium	,,	20,621	40,040
Petroleum Motor Spirit	1,000 gals.	70,664	49,406
Crude	,,	879,875	542,049

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	106	0	0
,, ,, 80% Technical	,,	97	0	0
Alum, Comml.	,,	25	0	0
Aluminium Sulphate	,,	16	10	0
Ammonia, Anhydrous	per lb.		2	0
Ammonium Carbonate	per ton	59	0	0
,, Chloride, 98%	,,	26	0	0
,, Phosphate (Mono- and Di-)	,,	102	0	0
Antimony Sulphide, golden	per lb.		3	0
Arsenic, White, 99/100%	per ton	47	10	0
Barium Carbonate (native), 94%	,,	Nominal		
,, Chloride	,,	53	0	0
Barytes (Bleached)	,,	20	0	0
Benzene	per gal.		5	2
Bleaching Powder, 35% Cl.	per ton	30	7	6
Borax	,,	46	0	0
Boric Acid, Comml.	,,	77	0	0
Calcium Carbide	,,	40	17	9
,, Chloride, solid, 70/75%	,,	13	5	0
Carbolic Acid, crystals	per lb.		1	6
Carbon Bisulphide	per ton	62	10	0
Chromic Acid (ton lots)	per lb.		2	2½
Citric Acid	per cwt.	9	15	0
Copper Sulphate	per ton	83	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.		1	2
Cresylic Acid, refined	,,		7	0
Hydrochloric Acid 28° Tw.	per carboy		13	0
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iron Sulphate	per ton	3	17	6
Lead, Carbonate, white	,,	117	10	0
,, Nitrate	,,	116	15	0
,, Oxide, Litharge	,,	107	15	0
,, Red	,,	105	15	0
Lime Acetate, brown	,,	40	0	0
Lithopone	,,	56	10	0
Magnesite, Calcined	,,	20	0	0
,, Raw	,,	9	0	0
Magnesium Chloride, ex Wharf	,,	16	0	0
,, Sulphate, Comml.	,,	15	10	0
Methylated Spirit, Industrial, 66 O.P.	per gal.		6	1
Nitric Acid, 80° Tw.	per ton	37	10	0
Oxalic Acid	,,	129	0	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	4
Pine Oil	per ton	Nominal		
Potassium Bichromate	per lb.		1	2½
,, Carbonate (hydrated)	per ton	74	10	0
,, Chloride	,,	21	0	0
,, Iodide	per lb.		6	10
,, Amyl Xanthate	,,	Nominal		
,, Ethyl Xanthate	,,	Nominal		
,, Hydrate (Caustic) flake	per ton	118	0	0
,, Nitrate	per cwt.		4	1
,, Permanganate	per ton	198	0	0
,, Sulphate, 50%	,,	20	13	0
Sodium Acetate	,,	75	10	0
,, Arsenate, 58–60%	,,	Nominal		
,, Bicarbonate	,,	18	10	0
,, Bichromate	per lb.		1	0
,, Carbonate (crystals)	per ton	Nominal		
,, ,, (Soda Ash) 58%	,,	13	15	0
,, Chlorate	,,	91	0	0
,, Cyanide	per cwt	6	6	6
,, Hydrate, 76/77%, solid	per ton	33	0	0
,, Hyposulphite, Comml.	,,	2	15	0
,, Nitrate, Comml.	,,	29	0	0
,, Phosphate (Dibasic)	,,	40	10	0
,, Prussiate	per lb.		1	0½
,, Silicate	per ton	11	10	0
,, Sulphate (Glauber's Salt)	,,	9	15	0
,, ,, (Salt-Cake)	,,	10	0	0
,, Sulphide, flakes, 60/62%	,,	38	12	6
,, Sulphite, Comml.	,,	27	15	0
Sulphur, American, Rock (Truckload)	,,	14	0	0
,, Ground, Crude	,,	17	10	0
Sulphuric Acid, 168° Tw.	,,	12	0	0
,, ,, free from Arsenic, 140° Tw.	,,	7	0	0
Superphosphate of Lime, 18% P_2O_5	,,	14	18	6
Tin Oxide	,,	Nominal		
Titanium Oxide, Rutile	,,	172	0	0
,, White, 25%	,,	85	0	0
Zinc Chloride	,,	95	0	0
,, Dust, 95/97% (4-ton lots)	,,	131	0	0
,, Oxide	,,	108	0	0
,, Sulphate	,,	32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	Feb. 9, 1960 £ s. d.	Mar. 8, 1960 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	4 8 9	4 0 0
Blyvooruitzicht (2s. 6d.)	1 9 3	1 7 6
Bracken (10s.)	—	1 10 6
Brakpan (3d.)	5 0	4 9
Buffelsfontein (10s.)	2 10 0	2 7 6
City Deep	19 6	19 3
Consolidated Main Reef	17 6	16 6
Crown Mines (10s.)	1 6 3	1 5 6
Daggafontein (5s.)	1 2 9	1 2 3
Dominion Reefs (5s.)	12 6	12 6
Doornfontein (10s.)	1 14 3	1 13 3
Durban Roodepoort Deep (10s.)	1 15 6	1 12 6
East Champ d'Or (2s. 6d.)	2 0	2 3
East Daggafontein (10s.)	8 9	9 0
East Geduld (4s.)	1 3 6	1 1 6
East Rand Ext. (5s.)	1 8 0	1 5 0
East Rand Proprietary (10s.)	2 1 0	1 17 0
Freddies Consol.	2 3	2 3
Free State Dev. (5s.)	8 0	6 9
Free State Geduld (5s.)	8 18 9	8 3 9
Free State Saaiplaas (10s.)	18 9	16 9
Geduld	3 13 9	3 3 6
Government Gold Mining Areas (3d.)	3 3	2 9
Grootvlei (5s.)	1 1 0	1 1 3
Harmony (5s.)	1 17 3	1 16 3
Hartebeestfontein (10s.)	2 18 6	2 17 0
Libanon (10s.)	16 3	14 9
Loraine (10s.)	1 15 3	1 13 6
Luipaards Vlei (2s.)	8 3	8 0
Marievale (10s.)	1 17 0	1 7 3
Modderfontein B (3d.)	2 0	2 0
Modderfontein East	15 9	14 3
New Kleinfontein	4 6	4 6
New Pioneer (5s.)	1 18 0	1 14 3
New State Areas (15s. 6d.)	1 3	1 0
President Brand (5s.)	3 15 3	3 10 6
President Steyn (5s.)	1 7 9	1 7 3
Rand Leases (9s. 3d.)	6 9	6 9
Randfontein	19 6	19 6
Rietfontein (3s.)	4 6	4 3
Robinson Deep (5s. 6d.)	6 0	5 9
Rose Deep (3s. 6d.)	9 6	9 6
St. Helena (10s.)	4 2 0	3 17 0
Simmer and Jack (1s. 6d.)	1 6	1 6
South African Land (3s. 6d.)	15 9	14 0
Springs (5d.)	1 9	1 6
Stilfontein (5s.)	2 0 0	1 15 3
Sub Nigel (3d.)	10 9	10 9
Vaal Reefs (5s.)	2 11 6	2 8 9
Van Dyk (3d.)	4 0	3 9
Venterspost (10s.)	1 2 6	1 0 9
Virginia (5s.)	5 3	4 6
Vlakfontein (10s.)	18 9	18 6
Vogelstruisbult (3d.)	6 6	6 6
Welkom (5s.)	1 0 9	19 3
West Driefontein (10s.)	9 12 6	9 3 9
West Rand Consolidated (10s.)	19 9	1 0 9
West Witwatersrand Areas (2s. 6d.)	4 0 0	3 12 6
Western Holdings (5s.)	8 15 0	8 3 9
Western Reefs (5s.)	1 12 0	1 9 3
Winkelhaak (10s.)	1 5 3	1 4 6
Witwatersrand Nigel (2s. 6d.)	1 3	1 3
Zandpan (10s.)	1 0 3	18 6
RHODESIA:		
Cam and Motor (2s. 6d.)	—	—
Chicago-Gaika (10s.)	1 5 0	1 5 0
Coronation (2s. 6d.)	6 0	6 0
Falcon (5s.)	11 9	10 6
Globe and Phœnix (5s.)	1 17 0	1 15 0
Motapa (5s.)	0 9	—
GOLD COAST:		
Amalgamated Banket (3s.)	1 6	1 3
Ariston Gold (2s. 6d.)	5 0	4 9
Ashanti Goldfields (4s.)	1 3 6	1 1 3
Bibiani (4s.)	3 9	3 3
Bremang Gold Dredging (5s.)	3 6	3 3
Ghana Main Reef (5s.)	3 6	2 9
Konongo (2s.)	2 0	1 9
Kwahu (2s.)	6 9	6 3
Offin River (2s. 6d.)	3 9	3 6
Western Selection (5s.)	6 3	5 9
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	1 9	1 9
Gold Mines of Kalgoorlie (10s.)	8 0	7 3
Great Boulder Propriet'y (2s.), W.A.	11 9	11 6
Lake View and Star (4s.), W.A.	1 6 6	1 8 0
Mount Morgan (10s.), Q.	18 6	17 9
New Guinea Gold (4s. 3d.)	1 9	1 9
North Kalgurli (1912) (2s.), W.A.	10 0	9 9
Sons of Gwalia (10s.), W.A.	2 9	2 9
Western Mining (5s.), W.A.	10 0	9 9

	Feb. 9, 1960 £ s. d.	Mar. 8, 1960 £ s. d.
MISCELLANEOUS:		
Fresnillo ($1·00)	1 12 6	1 12 6
Kentan Gold Areas	1 18 0	1 14 9
St. John d'el Rey, Brazil	4 7 6	4 10 0
Yukon Consolidated ($1)	5 0	5 0
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	1 6 9	1 4 6
Esperanza (2s. 6d.), Cyprus	2 6	2 3
Indian (2s.)	4 9	4 6
MTD (Mangula) (5s.)	12 3	11 6
Messina (5s.), Transvaal	6 17 0	6 6 3
Mount Lyell, (5s.) Tasmania	6 6	5 6
Nchanga Consolidated, N. Rhodesia	3 8 6	3 1 0
Rhokana Corporation, N. Rhodesia	3 6 9	3 1 6
Roan Antelope (5s.), N. Rhodesia	8 6	7 6
Tanganyika Concessions (10s.)	2 4 6	2 0 6
LEAD-ZINC:		
Broken Hill South (1s.), N.S.W.	13 9	12 3
Burma Mines (3s. 6d.)	1 9	1 9
Consol. Zinc Corp. Ord.	3 15 0	3 12 0
Lake George (5s.), N.S.W.	3 9	3 9
Mount Isa, Queensland (5s. Aust.)	2 15 9	2 12 6
New Broken Hill (5s.), N.S.W.	2 1 6	2 3 0
North Broken Hill (5s.), N.S.W.	6 10 0	6 2 6
Rhodesia Broken Hill (5s.)	11 6	10 0
San Francisco (10s.), Mexico	1 0 6	19 6
TIN:		
Amalgamated Tin (5s.), Nigeria	10 6	10 0
Ampat (4s.), Malaya	12 6	12 0
Ayer Hitam (5s.), Malaya	2 19 0	2 19 0
Beralt (5s.), Portugal	1 11 0	1 10 6
Bisichi (2s. 6d.), Nigeria	5 9	5 9
Ex-Lands (2s.), Nigeria	2 9	2 6
Geevor (5s.), Cornwall	1 2 3	1 3 3
Gold Base Metals (2s. 6d.), Nigeria	2 0	1 6
Hongkong (5s.), Malaya	6 3	6 3
Jantar Nigeria (3s.)	4 9	4 6
Kaduna Syndicate (2s.), Nigeria	2 6	2 6
Kamunting (5s.), Malaya	15 9	14 6
Malayan Tin Dredging (5s.)	1 1 3	19 9
Mawchi Mines (4s.), Burma	1 9	1 6
Naraguta Extended (5s.), Nigeria	1 9	1 7
Pahang (5s.), Malaya	9 3	8 9
Ribon Valley (2s.), Nigeria	10¼	0 9
Siamese Synd. (5s.)	12 3	11 9
South Crofty (5s.), Cornwall	6 3	5 6
Southern Kinta (5s.), Malaya	1 8 6	1 6 9
Southern Malayan (5s.)	18 3	17 6
Southern Tronoh (5s.), Malaya	14 0	13 6
Sungei Besi (4s.), Malaya	1 0 6	19 3
Sungei Kinta, Malaya	17 6	17 6
Tekka (12s. 6d.), Malaya	6 6	5 9
Tronoh (5s.), Malaya	1 9 6	1 16 3
DIAMONDS:		
Anglo American Investment	17 0 0	15 15 0
Consol African Selection Trust (5s.)	1 6 9	1 4 0
Consolidated of S.W.A. Pref. (10s.)	11 3	11 6
De Beers Deferred (5s.)	9 16 3	9 3 6
FINANCE, Etc.		
African & European (10s.)	4 5 6	4 6 3
Anglo American Corporation (10s.)	11 8 3	9 18 9
Anglo Transvaal 'A' (5s.)	2 11 3	2 9 0
British South Africa (15s.)	5 8 9	5 0 0
British Tin Investment (10s.)	1 8 6	1 9 6
Broken Hill Proprietary	3 4 0	3 2 6
Camp Bird (10s.)	11 9	11 3
Central Mining	4 11 6	3 17 0
Central Provinces Manganese (10s.)	1 15 0	1 14 9
Consolidated Gold Fields	4 12 6	4 3 6
Consolidated Mines Selection (10s.)	2 8 9	2 4 9
Corner House	1 2 3	1 0 9
East Rand Consolidated (5s.)	2	2 3
Free State Development (5s.)	8 0	6 9
General Exploration O.F.S. (2s. 6d.)	5 6	4 9
General Mining and Finance	7 0 0	6 5 0
Hendersons (4s.)	14 0	12 9
Johannesburg Consolidated	3 15 0	3 7 9
London & Rhod. M. & L. (5s.)	8 3	7 9
London Tin Corporation (4s.)	11 3	11 0
Lydenburg Est. (5s.)	17 6	16 0
Marsman Investments (10s.)	2 6	2 6
National Mining	2 9	2 9
Rand Mines (5s.)	5 3 6	4 15 0
Rand Selection (5s.)	3 11 9	3 1 6
Rhodesian Anglo American (10s.)	4 7 6	4 1 0
Rhodesian Corporation (5s.)	3 9	3 6
Rhodesian Selection Trust (5s.)	15 9	14 3
Rio Tinto (10s.)	2 3 9	2 0 6
Selection Trust (10s.)	6 0 9	6 0 9
South West Africa Co. (3s. 4d.)	18 9	16 0
Union Corporation (2s. 6d.)	4 4 0	3 15 6
Vereeniging	7 0 0	6 7 4
West Rand Inv. Trust (10s.)	3 8 0	3 4 3

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Geco Geology

A paper by W. L. Brown and others appearing in the *Canadian Mining and Metallurgical Bulletin* for January deals with "The Geology of the Geco Mine," which is situated in the Thunder Bay district of North-Western Ontario. The discovery by diamond drilling of a massive sulphide ore-body on Geco ground precipitated, during the winter of 1953–54, one of the greatest staking rushes in the history of the Province. By the spring of 1954 the existence of a major ore-body was indicated. On July 27 of the same year the Mining Corporation of Canada, Ltd., assumed control of Geco and immediately began to bring the property into production. Three years later, on September 9, 1957, production began and by mid November the mill was handling its rated capacity of 3,300 tons of ore per day. From the starting date to December 31, 1958, the total production had been 1,631,881 tons milled, averaging 2·46% Cu, 2·21% Zn, and 1·35 oz./ton Ag.

A cross-section from south to north across the Geco ore-body shows the following sequence of formations: Grey gneiss, including biotitic quartzite and thin-bedded quartzite; sericite schist, containing the ore-body, and biotite-amphibole-garnet gneiss. Intrusive into these formations are basic dykes, granite, pegmatite dykes, and diabase dykes.

The ore-body is cut by several north–south diabase dykes. These dip nearly vertical and vary in width from a few feet to 100 ft. The widest of them lies just west of the Fox Creek fault and is more or less parallel to it. These dykes are composed of plagioclase (andesine-labradorite) and pyroxene, with minor amounts of alteration products such as sericite, carbonate, and chlorite. A small amount of magnetite has also been noted.

An *S*-shaped drag-fold at the west end of the ore-body was formed during the period of folding which produced the Manitouwadge syncline. Although this fold plunges east at an average angle of 35° it shows considerable variation and has a plunge of 50° from surface to the 450-ft. level, 30° from the 450- to the 850-ft. level, and 40° from the 850- to the 1,250-ft. level. Indications of this fold were observed on the weathered-surface outcrops but, now that the West end of the ore-body has been mined through to surface, the bedding is much more evident as it passed around the synclinal and anticlinal portions of the drag fold.

The Geco ore-body itself is in reality one continuous zone with a horizontal length of nearly 2,400 ft. and an average width of about 65 ft., plunging parallel with the drag fold forming the lower or western portion of the ore zone. It is interrupted by several diabase dykes and is offset by the Fox Creek fault. For convenience, the ore zone is divided into three parts. The *A* ore-body is that portion west of the Fox Creek fault; the *B* ore-body is the portion from the Fox Creek fault to the shaft diabase, and *C* is the portion east of the shaft diabase.

The ore-bodies are made up of a core of massive sulphides consisting of the following minerals with their approximate percentages: Pyrite 20%; pyrrhotite 20%, sphalerite, 14%, chalcopyrite 6%, galena and marcasite less than 1%, the remainder being gangue. Although appreciable silver is present within the ore-body no silver minerals have as yet been recognized associated with the sulphides. It may occur in solid solution with the chalcopyrite, with which it appears to be directly related. The massive sulphides form a steeply-dipping tabular body, formed by the replacement of a breccia produced by the main strike fault. Angular unreplaced fragments of granular quartzite, pegmatite, and basic dykes, as well as vein quartz, are found as inclusions within the massive sulphides. The unreplaced fragments of pegmatite are more numerous in those portions of the massive sulphides which are contacted by pegmatite dykes. The massive sulphides continue uninterrupted through basic dykes and pegmatite dykes but are cut by the late diabase dykes. Where the larger pegmatites contact the massive sulphides they usually restrict the width of the massive sulphide ore. The lower termination of the massive sulphides plunges east at the same angle as the drag fold. This latter fact can be explained if it is considered that, where the strike fault passes through the more brittle granular quartzite, a broader breccia zone would be formed than where it cut the less competent beds adjacent to the grey gneiss contact.

The disseminated zone forms an envelope around the lower portions of the massive ore. Since the upper portion of the *A* ore-body has been removed by erosion a higher percentage of disseminated ore is present than in either the *B* or *C* ore-bodies. In the *A* ore-body the disseminated ore extends up to 200 ft. north of the main strike fault and up to 30 to 40 ft. south. The west limit of the disseminated ore reflects the configuration of the drag fold and suggests that, since the sericitic quartzite was more brittle, it became more highly fractured and thus a more favourable host rock than the underlying members of the grey gneiss series.

The portion of the *B* ore-body above the 450-ft.

level consists almost entirely of massive sulphides. Below this horizon the disseminated zone occurs on the north side of the massive sulphides in a similar manner to the west ore-body. The upper part of the *C* ore-body consists of massive sulphides, below which the disseminated zone gradually increases in width, but occurs largely on the south side of the massive sulphides, unlike the *A* and *B* ore-bodies. This apparent anomaly can be explained by the following facts : An altered bed of biotite-cordierite gneiss occurs south of the massive sulphides in the *C* ore-body and is almost absent in the *A* or *B* ore-bodies. The cordierite gneiss appears to be an excellent host rock, even more favourable for replacement than the sericitic quartzite on the north side of the massive sulphide.

No detailed study of wall rock alteration has been attempted as yet. The most obvious alteration within the mine area is the extensive formation of muscovite and sericite within the sericite schist horizon. This muscovite alteration extends in a minor degree to the upper horizons in the grey gneiss series, especially in the area under and west of the large drag fold. This latter area has also been sliced by strike faults along which minor sericite alteration has been introduced into the grey gneiss. The above complicating features have made it more difficult to work out the details of folding in the critical area of the drag fold. It is likely that the muscovite alteration took place after the strike faulting and closely preceded the introduction of the sulphides.

The distribution of the copper values within the disseminated zone shows that chalcopyrite replacement was concentrated along the main strike fault below the massive sulphides, as well as along the subsidary strike faults farther north. In section 7 + 50 East the subsidiary strike faults cut through the large flat pegmatite dyke. The higher copper values appear to follow along these faults to the lower contact of the pegmatite and then re-appear along the strike fault above the pegmatite, but very little chalcopyrite replacement occurred within the pegmatite. Apparently the pegmatite was not as favourable a host rock as the sericitic quartzite above and below. Contrary to what might be expected the flat pegmatites did not dam the ascending solutions to produce a concentration of copper values on the under side of the dykes.

Regarding the origin, the authors say granular quartzite now altered to a quartz muscovite schist is the host rock of the ore-body. A large *S*-shaped drag fold, related in time to the formation of the Manitouwadge syncline, plunges east at an average of 35° and controls the bottom, or west, end. Numerous basic dykes were intruded into the older rocks more or less paralleling the strike. A series of pegmatites and pegmatitic granite dykes related to the main granite cut these basic dykes and all the older rocks. A number of strike faults were formed, the most important of which has down-thrown the north side 175 ft. to 200 ft. This fault slices the syncline of the drag fold, truncates and displaces the pegmatites, and produces a fault breccia in the quartz muscovite schist. Pyrite, largely as well-formed cubes, replaced the fault breccia, leaving only a few angular pieces of schist and dyke rocks unreplaced. Some time after the consolidation of the pyrite mass further movement along the contacts fractured and brecciated the pyrite, facilitating its partial replacement by pyrrhotite. The next phase in the mineralization sequence was the replacement of the earlier sulphides by sphalerite and chalcopyrite. Of these, sphalerite, carrying minor chalcopyrite, was the first to invade the pyrite and pyrrhotite by permeating the brecciated edges and extending high up into the tabular mass. As the temperature dropped chalcopyrite replaced only the lower portions of the massive sulphides, since, by this time, the channelways to the higher portions were plugged by the earlier sphalerite. The copper solutions also gained access to the folded sericitic quartzite by way of the strike faults and formed the disseminated copper ore zones alongside of and below the massive sulphide ore. Basic dykes and pegmatites, where unbrecciated, prove themselves to be an inhospitable host rock for the replacing sulphides.

Aerial Exploration for Australian Uranium

In an article in the *Queensland Government Mining Journal* for June 20 last I. A. Mumme reviews "Aerial Exploration Methods of Prospecting for Uranium Mineralization in Australia." He refers to the combination of the scintillometer with aviation methods and says this technique has directly resulted from the inherent radioactive properties of the uranium minerals, which, emitting penetrating gamma-rays, can be detected at a distance in air providing the mineral deposits are exposed at the earth's surface or only covered by shallow alluvium. He says the basis of the method is to measure the gamma-radiation of the earth's surface. Generally this is carried out at low altitudes in aircraft carrying short meters of high gamma flux sensitivity which have short time constants. This enables the area to be flown over at reasonable speeds. However, owing to the fact that not only uranium but also thorium and radioactive potassium bearing minerals emit energetic gamma-ray photons and the fact that these minerals occur in small quantities in a host of rock types of sedimentary, igneous, and metamorphic nature ground investigations of aerial radiometric anomalies are necessary.

Many anomalies detected solely from the air may be valueless for the following reasons :—

(1) The aerial scintillometer does not generally distinguish between uranium and thorium deposits.

(2) Large areas of the surface rocks contain small quantities of thorium mineral, radioactive potassium (associated with potassium) mineral, radium salts, etc., which give rise to anomalies.

(3) Topographic changes, altitude changes, and solid angle effects of rock formations can give rise to radiometric anomalies.

Instrumental

The fact that not only the radiation flux due to radioactive bodies on the ground is detected by the scintillometer, but also cosmic radiation effects, gamma-radiation from radioactive emanations in the air, and radioactive contamination of the aircraft instrument dials, makes it essential that the HT on the photo-multiplier tube be set so that the $\frac{\text{signal}}{\text{noise}}$ ratio is an optimum value.

If excess radiation occurs in the aircraft due to luminous dials these rays must be satisfactorily screened off or the dials " de-luminized."

The average counting rate of the impulses due to the detection of the gamma-ray photons is determined by the integrating circuit. The pulses from the photo-multiplier tube are integrated to give the counting rate and are recorded on a graph showing gamma-ray intensity and location of aircraft. Due to the fact that the instrument has a finite response time there is naturally a difference between the actual instantaneous gamma-radiation intensity and the recorded gamma-ray intensity. The time constant must be set for suitable values corresponding to the speed of flight so that as much detail in the gamma-ray anomalies can be obtained as possible without introducing large fluctuations due to the random nature of the radioactivity detected. In areas of high anomalous radioactivity it is possible to use a shorter time constant to pick out the actual detail of the anomaly because the relative probable error is smaller in such an area than in areas where there are much lower radiation fluxes.

Results

A set of curves showing the variation of background radiation with elevation should be prepared so that the background effect can be subtracted from the actual gamma-ray intensities to analyse results of anomalies due to radioactive bodies mathematically.

In exploration by air of mountainous ranges distortion of the gamma-ray intensity field occurs due to severe topographic changes. It is possible to calculate these changes for simple geometrical shapes, but in areas where the topography changes in addition to the geology being complex, it is very difficult and consequently one must be apprehensive of radioactive anomalies located in very rugged terrain. It would be advisable to cover such terrain in helicopters at low speed and low and constant altitude above the land surface.

Since most surface rocks contain traces of radioactive minerals radiations from these sources are also detected by the instrument and constitute a portion of the background effect. Large areas of potash granite can give rise to quite significant readings on the scintillometer due to solid angle effects. These anomalies must not be confused with anomalies due to concentration of uranium minerals of economic value.

Surveys

The areas to be flown are chosen by the geologist as areas which are potentially uraniferous, where uranium-bearing lodes are likely to occur exposed at the surface or occur only covered by a thin veneer of soil.

For large-scale surveys two-engined planes are most suitable for reasons of safety. The instruments used include (apart from the conventional navigational instruments for piloting the aircraft) :—

(1) A mounted scintillometer, an associated 5-in. crystal and photomultiplier tube ratemeter, and recorder.

(2) A radio-altimeter and altimeter.
(3) Aerial photographic equipment.
(4) Possibly, shoran plotting equipment.

The crew engaged to carry out the survey (apart from a pilot and co-pilot) should comprise a geologist, geophysicist, and technicians. The function of the geologist is to make investigations from the plane of the geological structures and topography flown over during the surveys and differentiate between pronounced anomalies due to uranium ore-bodies and those due to topographical or geological effects. The function of the geophysicist is to bring to the geologist's attention radiometric anomalies which he considers may be significant.

For small surveys a single-engined plane is suitable and the crew should include a pilot, geologist, and geophysicist. An aerial scintillometer with a ratemeter showing changes in gamma-ray flux is sufficient for reconnaissance work. It is essential that both a geologist and geophysicist be engaged on such a survey, as it is possible to eliminate a lot of dead work which will otherwise result in investigating large numbers of radioactive anomalies of no significance.

Because of the fall-off of intensity of the gamma-radiation with height and distance from radioactive bodies it is desirable to carry out the aerial surveying at a reasonably low altitude, but not as low as to introduce any hazards or make piloting of the aircraft difficult.

Interpretation of Anomalies

The method of interpretation of the radiometric anomalies located varies greatly from area to area depending on the topography and the geological environment. In areas where there has been intense glaciation exposing bedrock, and where there is little covering soil, one of the signs to look for is localized sharp anomalies which may be associated with broader anomalies due to rock radioactivity and topographical changes.

In alluvial-covered areas of mature topography it is often more important to look for broad but isolated radiometric anomalies.

All possible geological information of the area should be utilized, including the following :—

(1) The radioactivity of springs and creeks in the area.
(2) The relationship of uranium mineralization to other forms of metalliferous mineralization.
(3) The nature and location of concentrations of thorium mineralization.
(4) The distribution of granites and the nature of their radioactivity.

If intense radioactive anomalies are located during the aerial survey then they should be flown at different heights and different approaches to determine their configuration—*i.e.*, whether a linear anomaly or a circular deposit, etc.

Radiometric anomalies which appear significant should be investigated on the ground by field parties, comprising geologists, geophysicists, and field hands, with bulldozers, portable drills, and assay equipment to determine their value.

Roof Falls and Gas Ignition

An explosion which killed two men occurred in April, 1958, in a Virginia bituminous coal mine during an induced roof fall in a section where electric circuits had been de-energized and face equipment had been removed. The gas had accumulated because ventilation had been disrupted in the area. Miners 50 ft. to 75 ft. from the fall reported seeing sparks and a flash of fire in the vicinity of the falling roof just before the explosion. The witnesses stated that during previous falls streaks of fire had been seen and sparks had been observed when the roof bolts ruptured.

Following the explosion the investigators, who were unable to assign an exact cause to the explosion, requested experimental evidence by the United States Bureau of Mines on the susceptibility of gas to ignition by frictional sparks and by ruptured or deformed steel. Based on the reported evidence four types of experiments were performed by the Bureau :

(*a*) Rubbing friction experiments, in which sparks were generated by holding a stationary specimen against a rotating specimen ;

(*b*) impact friction experiments, in which sparks were generated by a mass falling on to a stationary inclined specimen ;

(*c*) experiments in which a roof bolt was broken in tension, and

(*d*) experiments in which a roof bolthead was pulled through a washer and roof plate.

The purpose of the study was to determine some of the conditions required for generating incendive sparks and the relative tendency of mine rocks and steels to generate such sparks. The procedures in the first two groups of experiments are similar to those used in Germany and Great Britain, where considerable research has been conducted on ignition of gas by frictional sparks. In the last two groups of experiments tension was applied by hydraulic equipment on bolts in a gas chamber. An account of this work is given in Report of Investigations 5548 of the Bureau of Mines by J. Nagy and E. M. Kawenski.

Ignition of gas by frictional sparks is not a new problem, the authors say, but the exact mechanism of ignition of gas by frictional sparks is unknown ; it has been shown by other investigators that :

(1) The visibility of sparks is not a criterion for ignition, as many highly luminous sparks are non-incendive.

(2) The ignition frequency increases with impact energy and material hardness.

(3) The impinging of sparks on an obstruction increases their incendivity.

(4) The gas concentration is a parameter ; for methane, a concentration of 6% to 7% gas appears to be most easily ignited by frictional sparks.

(5) In impact friction (aluminium striking steel) the rustiness of the steel (thermit reaction) and angle of impact are factors. The ignition frequency increases with relative humidity.

(6) Among rocks the quartz-bearing sandstones present the greatest frictional ignition hazard; shale is less dangerous than sandstone, and pyrite inclusions generally increase incendivity.

(7) Metal-to-metal contacts generally produce less-incendive sparks than metal-to-rock contacts. The reportedly " non-sparking " metals produce incendive sparks under some conditions.

After an account of the experimental work the authors give the following conclusions :—

In limited experiments performed gas was ignited by friction sparks between mine rocks and between mine rocks and roof-bolt steel.

Of the materials studied incendive frictional sparks were formed at the lowest speed and smallest load with sandstone-sandstone contact. Gas ignitions were produced readily with shale rubbing on a sandstone wheel and less readily with sandstone or shale rubbing on a roof-bolt wheel. The lowest peripheral speed of the rotating wheel for ignition would be equivalent to a free fall of 2·2 ft.—a distance readily obtained in the Virginia coal mine. In the tests a 7% gas-air mixture was more readily ignited by frictional sparks than an 8% or 9% mixture. The incendivity of the sparks increased with the load and the speed of the wheel. Although ignitions occurred within 1 sec of the time of contact of the surfaces more often they occurred in 10 sec. to 30 sec. The presence of visible sparks cannot be taken as a criterion of incendivity, as visible sparks occurred whether ignition resulted or not.

Ignitions were not obtained by impact friction, by roof bolts broken in tension, or by roof boltheads pulled through a washer on the roof plate. Sparks generally were visible in the drop trials but not in the pull experiments. These tests cannot be considered as conclusive evidence that such sources may not cause ignitions under some circumstances. The energy expended by falling masses of rock and the rate of tensile loads applied on roof bolts during a mine roof fall could far exceed those studied in the laboratory.

Because incendive sparks can be produced so readily and with so little expenditure of energy it is virtually impossible to eliminate them in coal mining. Gas ignitions by this source must be prevented by other measures. One of the most effective measures is adequate ventilation to prevent an accumulation of gas.

The Mineral Industry in Australia

The leading article in the most recent issue of the *Quarterly Review* of the Australian Mineral Industry, published recently, deals with " Australian Gemstones." This shows that because of the growing popularity of the Australian opal in Japan that country has now become by far the leading buyer of the stone, although the United States has been a consistent purchaser since World War II. Japan entered the market in a substantial way four years ago and since then the value of exports to Japan has increased to a surprising extent. That country's purchases of Australian opal increased in value from £5,780 in 1955 to £164,969 in 1958. The U.S.A., now relegated to second highest buyer, bought opal worth £74,393 in 1958. The total value of all exports of opal from Australia in 1958 was

£351,342, which was the highest figure ever recorded.

Japan's appearance in the market has had considerable impact on the industry in that substantial sales of other than first-quality stone have been possible. The keen overseas demand in recent years has heightened interest in the industry and the numbers working on the Andamooka and Coober Pedy fields, in South Australia, where the largest operations are now taking place, have increased. Modern earthmoving and other equipment are now being applied successfully to opal mining which may well lead to new fields being established and a significant increase in production.

Most of the important gemstones occur in Australia, but in terms of total value the output has been extremely small. In spite of the revival in opal mining, particularly since World War II, the total recorded value since the end of last century has been only £3,200,000.

The *Review* also gives the following summary of the latest Australian position of some of the important minerals :—

Aluminium.—Production of aluminium at Bell Bay has been maintained at capacity levels throughout 1959 and was 11,945 tons to the end of November.

Copper.—On the basis of information available to the end of October mine production of copper seems certain to exceed 90,000 tons for 1959, compared with 73,000 tons in 1958. As a result of the opening of the Townsville refinery production of refined copper has increased and refined copper is now being exported.

Gold.—Although gold production in the first three-quarters of 1959 was slightly below that in the same period of 1958 it is expected that the total for the year will be about 1,100,000 oz. or about the same as in 1958.

Lead.—Mine production of lead in 1959 was about 315,000 tons, compared with 327,000 tons in 1958, and 334,000 tons in the record year, 1957. Production of refined lead in 1959 was about 189,000 tons and bullion for export about 50,000 tons. Exports of bullion and refined lead in 1959 were lower than in 1958.

Tin.—Mine production of tin in the first half of 1959 was at a slightly better rate than in the previous year.

Rutile, Zircon, and Ilmenite.—There has been some improvement in zircon production consequent upon an improvement in the market outlook, but rutile and ilmenite prices continue at low levels. There appears to be no immediate prospect of a worthwhile increase in rutile and ilmenite prices and production continues below capacity levels.

Zinc.—Mine production of zinc in 1959 was about 250,000 tons, a fall of about 13,000 tons on the 1958 level and 40,000 tons from the peak achieved in 1957. On the other hand, production of refined metal has been maintained at capacity levels and was about 115,000 tons for the year.

A Water Slurry Explosive

In the *Canadian Mining Journal* for January an account is given of construction work on a mining project in which an ammonium nitrate aqueous slurry is being used as the blasting agent. The Quebec Cartier Mining Company is building a railway north to its iron-ore development at Lac Jeannine. Completion of the railway is scheduled for the end of 1960 and first shipments of ore early in 1961. The ore will be concentrated at the site by one of the world's largest concentrating plants and shipped down the railway to a deep-sea harbour under construction west of Shelter Bay. This harbour, capable of handling ore carriers of the largest foreseeable size, will be nearly a half-mile long and 50 ft. deep at low tide. It is being blasted " in the dry " out of solid rock, a job that requires the excavation of approximately 7,000,000 cu. yd. of rock.

This project is being carried out by Canit-Janin, a joint enterprise of Canit Construction (Quebec) and A. Janin and Co., Ltd. Because of the large quantities of rock that must be excavated blasting is a major factor in this job. Canit-Janin is using " Hydromex," a powerful blasting agent with unusual properties developed by C-I-L in co-operation with the Iron Ore Company of Canada. " Hydromex," which has the consistency of thick soup or porridge, is packed in polythene bags. Perhaps its most unusual feature is that it contains water—normally undesirable in explosives. However, the water actually takes part in the detonation reactions, increasing the gas volume and borehole pressure. Because it is water compatible the explosive performs well under both wet and dry conditions. This is the first time this new explosive has been used on a large scale in construction and studies have been carried on to develop the most economical method for using it on the job.

There is also much blasting in the construction of the railway which is being driven through some extremely rugged country. The contractor is Pitts-Foley—a combination of C. A. Pitts General Contractor, Ltd., Toronto, and Foley Bros., Inc., of Pleasantville, N.Y. Many cuts are being blasted in the granite hills. One 1,400-ft. tunnel has been driven at Mile 26 and another one has recently been holed through Mile 90. In a canyon north of Mile 150 where the cliffs are 1,000 ft. high several other tunnels are planned. Temiskaming-Inspiration holds the tunnel contracts.

Trade Paragraphs

Griffin and George, Ltd., of Alperton, Wembley, Middx., state that they have received another order from China for their gas-liquid chromatographic analysis apparatus, bringing the total supplied to nine.

Hadfields, Ltd., of Sheffield, issue a leaflet which describes the types of pressure vessels they manufacture as forgings, castings, fabrication, iron castings, centrifugally cast steel, iron or non-ferrous metal, or combinations of these methods.

Crofts (Engineers), Ltd., of Bradford, in a recent illustrated leaflet describe their free space hydraulic couplings and drives available from stock for drives up to 100 h.p. at 1,450 r.p.m. and also supplied for powers up to 700 h.p.

John Fowler and Co. (Leeds), Ltd., of Hunslet, Leeds, have published a 24-page illustrated brochure describing their range of diesel shunting locomotives containing as power units suitably approved engines, having hydraulic or mechanical transmission, with wheel arrangements 0–4–0 or 0–6–0, multiple units for tandem working if required, and flame proofing as necessary.

Richard Sutcliffe, Ltd., of Horbury, Wakefield, announce that Mr. M. R. Moore has been appointed

general sales manager. After having been the company's district technical manager for the Northern and Durham Divisions of the N.C.B. for ten years he became manager of the mining and general products department in September last.

George Angus and Co., Ltd., of 152–158, Westgate Road, Newcastle upon Tyne, have introduced a range of safety helmets which are the subject of a new colour illustrated leaflet just published. Made either of plastic or glass fibre they combine light weight with great strength and allow ample clearance between the top of the head and the helmet shell as well as exceptional resistance to penetration.

Holman Bros., Ltd., of Camborne, in a recent notice state that the Sinai Manganese Co. plan to step up its production to 200,000 tons of run-of-the-mine manganese ore. A re-equipment programme to bring this about has resulted in the placing of orders with British companies for mining plant, transportation equipment, and spare parts. First of the orders to be placed is for three Holman Rotair compressors. each of 600 c.f.m. capacity.

Turner Brothers Asbestos Co., Ltd., of Rochdale, have published a 40-page illustrated catalogue of Cord V belts which is complete with tables for standard drives in five sections—$\frac{1}{2}$ in. by $\frac{5}{16}$ in., $\frac{41}{32}$ in. by $\frac{13}{32}$ in., $\frac{7}{8}$ in. by $\frac{17}{32}$ in., $1\frac{1}{4}$ in. by $\frac{3}{4}$ in., and $1\frac{1}{2}$ in. by $\frac{29}{32}$ in. A complete section on V-belt drive design also gives useful mathematical data and tables of horse-power rating. The catalogue may in fact be said to cover all aspects of transmission drives.

Firth Cleveland Investments, Ltd., of Stornoway House, Cleveland Row, London, S.W. 1, issue notes on a new pressure bulb type hydrostatic tank contents gauge, which will measure the head of liquid in most types of non-pressurized tank. Its indicator can be placed up to 250 ft. from the tank to show by a dial and pointer either the depth of liquid or the tank contents. It is supplied as two units, transmitter and indicator, together with suitable airline and connectors.

Flexible Valve Corp., of 400, Commercial Avenue, Palisades Park, New Jersey (represented by Farris Engineering, Ltd., Maidstone Road, Rochester, Kent), issue an illustrated folder describing their Flex valve which is made standard with 125 ASA dimensions in the flanges or with four clamps in the sleeves in place of flanges. Flanges may be furnished on one end only. Slip-on types range from $\frac{1}{2}$ in. to $2\frac{1}{2}$ in. and flanged from 1 to 12 in. Maximum line pressures to 125 p.s.i. and temperatures to 180° F. or higher on application.

Joy-Sullivan, Ltd., of 7, Harley Street, London, W. 1, have produced from their Air Power Division some leaflets describing products in the range manufactured. These include Speedline rock-drills —L 37, L 47, and JAL 47, the last being an airleg mounted drill—and the Airvane 365 and 600 portable air-compressors both of the rotary type with diesel engines by three alternative makers—General Motors, Cummins, or Rolls-Royce. The first is for deliveries of 365 c.f.m. at 100 p.s.i.g. and the second, 600 c.f.m. at the same pressure.

Caterpillar Tractor Co., of Peoria, Illinois, and P.O. Box 162, Glasgow, announce a new D6 Series B tractor. Among the features are: A completely new engine that gives the tractor 25% greater power, two hydraulic control units now integrally mounted, a tilt cylinder for special applications, an optional transmission for jobs calling for higher drawbar pull, and a new design of operator's compartment. The engine delivers 93 flywheel horsepower at 1,600 r.p.m., the hydraulic control pump and tank being located at the rear under the hood.

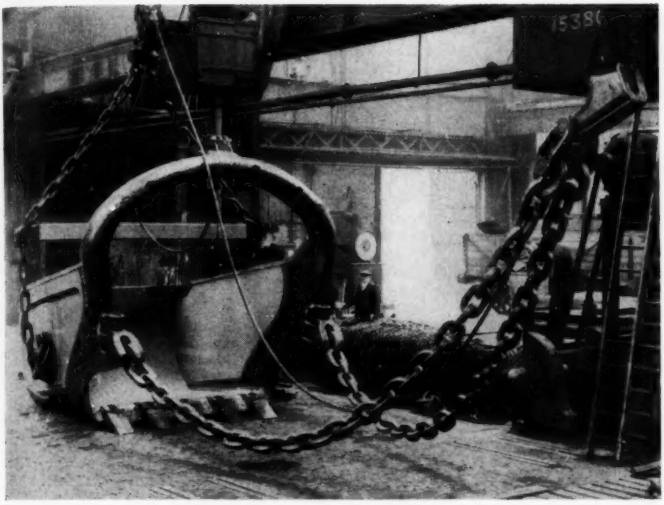
Yale and Towne Manufacturing Co. from their British Materials Handling Division at Wednesfield, Wolverhampton, Staffs., announce the introduction of the British version of the tractor shovel marketed in America under the name "Trojan". It will be sold in the United Kingdom by Jack Olding and Co., Ltd, of Hatfield, Herts., as the Yale tractor shovel. The first model is the 154LD, a four-wheel drive shovel of 12,000 lb. lifting capacity, normally fitted with a 2-cu. yd. general utility bucket, optional sizes of $1\frac{1}{2}$ and $2\frac{3}{4}$ cu. yd. being available for heavy and light materials.

General Electric Co., Ltd., of Erith, Kent, state that their associated company in Johannesburg has received contracts for two coal-preparation plants worth approximately £230,000. The Chance sand flotation process will be employed in both installations and the plant will be supplied by G.E.C. The primary screening and conveying sections of the plant will be provided by Robins Conveyors (S.A.), Ltd., with whom the G.E.C. has close relations in this class of work. The first plant will be situated at the Landau Colliery of the South African Coal Estates (Witbank), Ltd., and the second is for Natal Navigation Collieries and Estate Co., Ltd.

British Nylon Spinners, Ltd., of 68, Knightsbridge, London, S.W. 1, state that the consumption of nylon yarn for conveyor belting during 1959 was three times as great as during the previous year and was still rising. Solid-woven belting containing a substantial proportion of nylon is, of course, firmly established. It has been gradually improved during the past few years and now has a very high reputation for toughness and durability. Inspired by this success manufacturers have devoted great effort to the development of plied belting containing nylon. This work has been encouraged by the introduction by the N.C.B. of a "limited approval" scheme under which quantities of about 50,000 to 100,000 ft. of promising-looking belts containing man-made fibres are being bought.

Henry Wiggin and Co., Ltd., of Thames House, Millbank, London, S.W. 1, are to hold an exhibition at Park Lane House, 45, Park Lane, London, W.1. from March 21–25. It will be open daily from 10 a.m. to 8 p.m. (5 p.m. on Friday 25th) and the aim is to help engineers and designers to make the best use of the specialized alloys manufactured by the company. These alloys fall mainly into four groups, corrosion-resisting, heat-resisting, electrical resistance, and materials with special properties. During the exhibition a series of lectures will be given on subjects including fabricating the high-nickel alloys and others on the uses of high-nickel and nickel-base alloys in the production of nuclear power, in heat-resisting applications, in the electrical and electronic industries, and in chemical engineering.

Armour Hess Chemicals, Ltd., of 4, Chiswell Street, Finsbury Square, London E.C. 1, issue some notes on long chain amines, such as Armeen HT (made from hydrogenated tallow), Armeen 18 (pure octadecyl amine), and others, together with their acetate salts, which have melting points in the region of 55° C. and are difficult to empty from drums. In many cases, to facilitate removal from the drum, the material has to be melted which is an



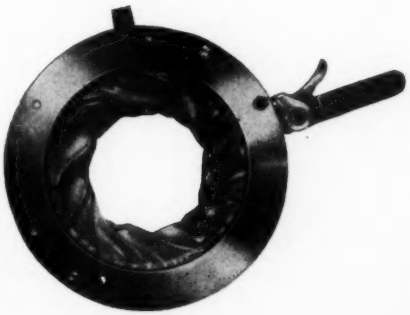
Hadfields Dragline Bucket Arch.

expensive and awkward operation. The company now supply these chemicals in flaked form. Packed in 100-lb. net fibre kegs they are free flowing and easily handled, which is of particular advantage where these cationic surface-active chemicals are used in water treatment or in mineral flotation—in fact, wherever accurate dosing in small amounts is necessary.

Electronic Instruments, Ltd., of Richmond, Surrey, state that the first Canadian order for their titromatic analyser has been received from the Aluminum Company of Canada. The Canadian requirements created a particularly difficult problem because of the corrosive nature of the reagents required in the assay. The analyser is designed to assay the aluminium content and the free alkali of five separate ore plant streams. To perform this it automatically carries out a double end-point titration with two added reagents on each of the five streams. The ore liquor is highly corrosive and all taps, vessels, and piping in contact with it are P.T.F.E. lined. To avoid scale formation the complete sampling system is flushed frequently with water and acid. After every titration the electrode system is cleaned by mechanical brushing under alternate sprays of acid and water.

Blaw Knox, Ltd., of 94, Brompton Road, London, S.W. 3, announce a new loading shovel—the BK. Hydroscoop, to handle up to 350 cu. yd. per hour for a consumption of less than 70 h.p. Working in granite, limestone, sandstone, and heavily-compacted soil, it has maintained high output figures with economy and reliability. For rehandling work the 2 cu. yd. bucket is standard but for lighter materials larger buckets can be fitted. Raising and lowering of parallel linkage is by hoisting line and clutch and brake drums are booster operated and controlled through foot pedals. Bucket thrust and break-out operations are hydraulically operated and a digging force of 26·5 tons is exerted at the bucket teeth. It has a 360° swing with 20 ft. level clean-up radius and it will dig any angle of slope and excavate to 2 ft. below ground level. A maximum discharge height of 9 ft. 10 in. (3 m.) assures ample clearance to load the largest capacity dumpers and wagons.

Mucon Engineering Co., Ltd., of Stonefield Way, South Ruislip, Middx., make available some details of the Mucon valve, designed to control the flow of substances in bulk storage being dispensed into sacks, bins, or other containers and illustrated here. It can act as a regulator valve, an isolation valve, and for other purposes, and has an infinitely-variable central orifice obtained from the fabric diaphragm. The makers suggest that as the number and variety of possible applications for Mucon valves is very great much depends on an appreciation of where each type of valve may be used to advantage, added to a knowledge of the working conditions. The economics of a correctly-installed valve is such that great saving can be made if the valve is correctly applied and installed. Valve dimensions for installation purposes are given on separate leaflets describing each series of valve. Standard valves are



made in cast aluminium alloy and gunmetal. Special quotations will be given for valves made in other metals or plastics.

Visco Engineering Co., Ltd., of Stafford Road, Croydon, in a new publication give details of the KM oil-wetted air filter, in which the filtration medium consists of galvanized wire mesh made from flattened wire and crimped to induce extreme air-turbulence which results in high efficiency. The standard unit measures 20 in. by 20 in. and is approximately 2 in. deep and comprises a sheet-metal frame enabling any number of units to be bolted together to form a complete installation. The filter cell is of a channel-section construction filled with filter medium which is retained between two sheets of flattened expanded metal. The cell is held in position in the frame by two quick-release catches which are also the handles. By simply pushing the handles flat against the cell it is locked securely into the filter frame. It is therefore only a matter of seconds to take out or replace a filter cell. In operating the plant under site conditions it is usual to have a certain percentage of spare clean and oiled filter cells which can be placed in position quickly and easily, thus ensuring that the filter plant is out of commission for a few moments only.

Thermotank, Ltd., of Helen Street, Glasgow, refer to a major advance in the design of cooling towers in a recent announcement. This new type of tower, weighing less than half as much as conventional towers of similar capacity, affords a saving in both weight and size and is achieved by the use of a revolutionary fill material in which the water is cooled by a counter-current of air as it passes through very closely-spaced elements. Until now the performance of cooling towers has depended on relatively widely-spaced elements which were not really wettable. The fill used in the Thermotank tower introduces a new principle. It is a lightweight plastic-impregnated cellulose material, combining outstanding qualities of water absorption with high resistance to deterioration under operating conditions. Water is distributed from a self-propelled rotating header at low pressure, forming a thin continuous film over the entire fill surface, which is such an efficient compact heat-transfer medium that it takes up only one-fifth of the space of conventional wooden slats.

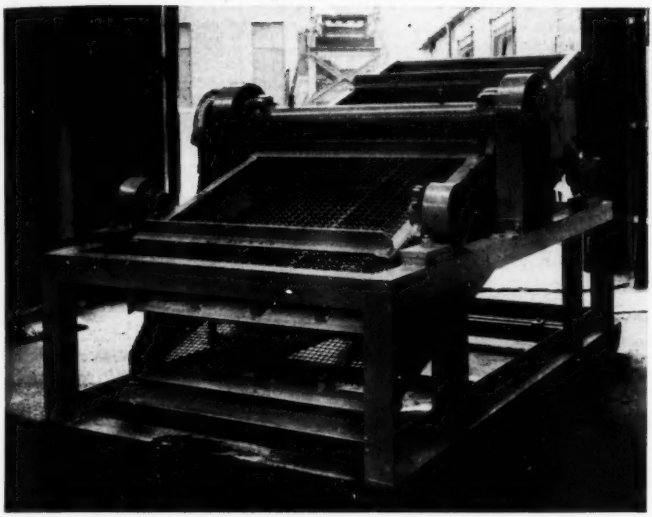
W. C. Holmes and Co., Ltd., of P.O. Box B7, Turnbridge, Huddersfield, have made a further addition to their range of dust collection and control plant—the Holmes-Retroflux bag filter, developed by Standard Filterbau Gesellschaft m.b.H. of Munster and to be manufactured under licence in the U.K. It is described as particularly suitable for those applications where high dust burdens are encountered and/or dusts of an adhesive nature have to be collected. In operation, the dust-laden air enters the header within the casing and is distributed to the inside of the filter bags, the air and dust moving in the same direction. The tendency of the dust to settle by gravity is not impeded by air currents as the air passes through the filter bags radially and the air velocity gradually diminishes to zero at their lowest end. The dust collected on the inner surface of the filter bags is continuously dislodged by the passage of high-velocity air jets through the fabric in the reverse direction to the main air stream. The dislodged dust falls by gravity to the worm conveyor or hopper below.

Associated Electrical Industries (Rugby), Ltd., of Rugby, recently secured an order for a 108,000-kW rectifier installation for use in aluminium smelting from Ardel og Sunndal Verk. The order covers semi-conductor rectifier equipment rated at 135,000 amp., 800 volts d.c. and the plant is to be commissioned and in commercial operation early in 1962. It is understood that A.E.I. germanium rectifiers were selected on the technical merits of the equipment put forward compared with other similar types of rectifiers and on the successful operating experience already obtained in service.

Another announcement by the company refers to the largest a.c. winder so far commissioned in Australia and the first to be fitted with power-operated brakes. The unit, driven by a 1,100-h.p., 570-r.p.m., 6,600-volt, 50-cycle slipring induction motor, is designed to raise 300 tons of coal an hour from a depth of 720 ft. Speed variation and direction of winding are governed by a liquid controller and an air-break reversing contactor. A single-reduction gearbox connects the motor to the winding drums, the maximum speed of which is 68 r.p.m. In addition to the mechanical brakes the driver has an electrical braking system which incorporates regenerative braking, reverse current braking, and dynamic braking.

United Steel Companies, Ltd., of The Mount, Broomhill, Sheffield, refer to the Distington-Goodman ropebelt conveyor. This new type of conveyor, using wire rope for side frames and flexible idler assemblies, was introduced to Britain in 1958, the sole agents being Distington Engineering Co., Ltd., of Workington, Cumberland. It was originally developed by the Goodman Manufacturing Co. of Chicago, who hold British patents on the basic structure, which has proved outstandingly successful in America. Distington holds its own patents on development work carried out during the past 18 months in order to produce a structure specially suited to conditions in British coal mines. Analysis of the first 50 installations shows that the conveyor is being used for handling rippings, as a rock conveyor on major development work, as a gate conveyor, or as a trunk conveyor for carrying coal. It is working smoothly behind virtually every type of existing loader and on gradients of up to 1 in 3 in favour and against the load. Many of the installations are being extended regularly as the face advances. At present the longest floor-mounted installation is 1,000 yd. and the longest suspended structure 300 yd. In several cases floor-mounted and suspended structure have been incorporated in one conveyor to overcome floor or roof obstacles.

Armstrong Whitworth (Metal Industries), Ltd., of Gateshead, recently stated that Overstrom screens are to be manufactured under licence and that they have the rights for sales throughout the world, with the exception of the Americas and New Zealand. The screens are built for wet or dry, light, medium, and heavy service and there are seven sizes ranging from 3 ft. by 18 in. to 16 ft. by 6 ft., each of which can be equipped with one, two, or three decks. All can be fitted with partial or complete dustproof enclosures, water-spray equipment, and heating units such as are sometimes required for the finer-mesh decks dealing with sticky materials. The first British-made screen is now being installed at Kirkwhelpington to work in conjunction with a large Kue-Ken crusher and is an 8 ft. by 4 ft. single-deck assembly with a 2½ in. square mesh which will be screening quartz-dolorite.



Overstrom Screen.

A number of features of note are included in the design and the most important of these are: No eccentric mechanism is involved to produce the rocking action. Vibration is set up by having unbalanced flywheels mounted at the ends of a plain shaft in the vibrator unit which is fixed rigidly on the screen box. Rotated at high speed the flywheels set up in the spring-mounted screen a motion which is directly contrary to their own movement. The amplitude of the screen rocking action is directly proportional to the amount of unbalanced weight in the flywheels and is independent of the speed of the rotation. It can be adjusted to suit varying feeds by adding or removing the counterweights bolted to the inside of the flywheel rims. No counter balancing is necessary to prevent transmission of vibration to the supporting structure. The undesirable side-swaying motion which is common in screen applications is eliminated by the use of involute springs of high strength and low stiffness. The motion is transmitted into an elliptical motion described below and 98% isolation of vibration is achieved.

An important feature is that screening begins the moment the material is placed at the feed end—as opposed to a general blinding at this end before vibration begins to work about the centre of the screen. A forward elliptical motion at the feed end moves oversize material rapidly out of the way. In the centre the action becomes a circular movement which slows down the rate of travel and at the delivery end a backward elliptical motion retards the flow and allows greater time for the near-size material to find openings in the screen cloth. Substantial stripping of the supporting structure is unnecessary when replacing screen cloths. Stretcher-bar lifting springs automatically disengage the bar from the hooked edge of the screen cloth when exterior tension bolts are loosened and the cloth can be withdrawn.

Engineering Materials and Design Exhibition

As mentioned in the February issue the Engineering Materials and Design Exhibition was held at Earls Court from February 22 to 26 in conjunction with a conference at which papers were presented on a variety of related topics—such as beryllium, powder metallurgy, reinforced plastics, rubber in engineering, developments in fluid power, cast iron as an engineering material, and standards in design—to mention some of the more outstanding.

The exhibition, which is the first of its kind to be held in this country, contained the largest and most varied selection of materials and components for engineering designers yet shown here and served to emphasise the rapid growth in the variety of engineering materials since the war. The materials and components shown included traditional steels, irons, and brasses, as well as some of the newer metals like titanium and beryllium. The increasing applications of stainless steel were made evident in the form of castings, extrusions, and shell mouldings, showing how this material is expanding its uses in the fields of nuclear energy and the chemical and processing industries. Plastics also are playing an ever-increasing part in engineering design and many exhibits reflected this trend, including the combination of metal and plastics to produce a component with properties which neither material on its own can provide. Nylon was shown in versatile applications for collapsible tanks and in the form of special mouldings such as a marine propeller. Unusual forms of raw materials in the shape of tubes and rods were shown by examples of polypropylene and polycarbonate up to 8 in. diameter and sheets up to 3 in. thick. Nylon was also shown in a sintered form for applications demanding superior wear and frictional properties combined with outstanding dimensional stability.

One of the greatest application of plastics is in the coating of steel and articles up to 5 tons in weight and 17 ft. long can now be covered with a heavy deposit of P.V.C. and polythene. Several exhibitors demonstrated the growing applications of sintered metal components, while two companies showed the important contributions to technology now being made by ceramics, components used by the electrical, chemical, and textile industries including pump seals and high-temperature furnace equipment. Interesting developments in needle bearings indicated the increasing popularity of these components on account of their light weight, high load-carrying capacity, and compactness. Another interesting type of needle bearing of a self-aligning type is recommended to limit shaft misalignment.

Shown in the illustration is an example of a product in a stand jointly arranged by members of the British Steel Founders Association. It is a large dragline bucket made by **Hadfields, Ltd.,** who also showed a top dredge tumbler. Particular note may also be taken of the following :—

British Nylons Spinners, Ltd., showed a 100-ft. "Dracone"—a vast sausage-like container to enable oil and other liquid cargoes to be towed through water—made from proofed nylon. Collapsible tanks for carriage of liquids in bulk on lorries or other wheeled vehicles are also postulated.

Imperial Chemical Industries, Ltd., from their Metals and Nobel divisions showed titanium and zirconium products and special copper alloys and silicone rubbers and resins, lubricants for high and low temperature uses, and antifoam agents.

Johnson, Matthey and Co., Ltd., featured low-temperature brazing and a range of silver brazing alloys. The standard range of Mallory resistance-welding products, fabricated from specialized copper-base alloys, were also demonstrated, as well as electrical contacts. Products for the electronic industry include resistance wires in noble and base-metal alloys, nickel cathode tubes, silver and silver-lined waveguide tubes, and silvered mica capacitor plates. For the instrument manufacturer platinum for resistance thermometry and platinum : rhodium-platinum thermocouples are other important products, also Mallory 1000 high-density material and a cobalt-platinum permanent magnet alloy.

Morgan Crucible Co., Ltd. A section was devoted to a display of sintered-metal oil-retaining bearings, supplied in stainless steel, copper-iron, and other alloys as well as bronze. Silicon carbide furnace heating elements completed the display. These new non-metallic elements are made in a range of sizes that lead to simpler more compact and economical furnaces.

Ruston and Hornsby, Ltd., displayed Ruston-Grayloc high-pressure high-temperature all-metal connexions to match standard pipe sizes from 1 in. to 30 in. butt weld, socket weld, or threaded. They consist of a seal member with lips, hubs on which the lips bear to form the seal, and a two- or three-bolt clamp. They may be repeatedly broken and re-made, using the same seal member.

Henry Wiggin and Co., Ltd. Wrought nickel in all commercial forms. Nimonic high-temperature alloys. Nimocast high-temperature casting alloys. Monel nickel-copper alloy. Inconel nickel-chromium alloy. Corronel corrosion-resisting alloy and Ni-o-nel nickel-iron-chromium alloy for corrosion resistance. Nilo series of controlled expansion alloys. Thermo-metal for bimetallic temperature controls. Nickel anodes for electroplating.

NEW BOOKS, PAMPHLETS, ETC.

☛ Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

The Mines of Cornwall : (1) The Land's End Peninsula. Statistics and Observations by THOMAS SPARGO, 1865. Paper covers, 30 pages, illustrated. Price 4s. 6d., post free. Truro : D. B. Barton, Truro Bookshop.

Trace Techniques : Using the K 1000 Cathode Ray Polarograph—Vol. 1. By J. HETMAN. Paper covers, 48 pages, illustrated. Price 25s. Camberley, Surrey : Southern Instruments, Ltd.

Somaliland Protectorate : Annual Report of the Geological Survey Department, April, 1958—March, 1959. Paper covers, 21 pages. Price Shs. 2. London : Crown Agents for Oversea Governments and Administrations.

Mineralogy of Beach Sands between Halfmoon and Monterey Bays, California : California Division of Mines Special Report 59. By C. O. HUTTON. Paper covers, 32 pages, illustrated. Price 50 cents. San Francisco : Department of Natural Resources.

Northern Rhodesia : The Karroo System and Coal Resources of the Gwembe District, South-West Section. N. Rhod. Geol. Surv. Bull. No. 4. By R. TAVENER-SMITH. Paper boards, 84 pages, with 17 plates and two maps. Price 30s. Lusaka : Ministry of Labour and Mines, Geological Survey.

Geology and Mineral Resources of the Lake Elsinore Quadrangle, California. Division of Mines Bulletin 146. Cloth, octavo, 154 pages, illustrated, with maps. Price $2.50. San Francisco : Department of Natural Resources.

Imperial College of Science and Technology : Postgraduate Courses, 1960–61. Paper covers, 113 pages. South Kensington : Imperial College.

Kempe's Engineers Year-Book, 1960 : In two volumes in case (3,000 pages), illustrated. Price 87s. 6d., plus 2s. 6d. postage. London : Morgan Brothers (Publishers), Ltd.

RECENT PATENTS PUBLISHED

☛ A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

22,658 of 1954 (826,932). SEISMOGRAPH SERVICE (ENGLAND), LTD. Methods and apparatus for seismic survey of geological formations.

7,135–6 of 1955 (826,634–5). BRITISH ALUMINIUM CO., LTD. Electrolytic cells for the production of aluminium.

17,370 of 1955 (826,667). P. SPENCE AND SONS, LTD. Electrolytic production of titanium.

4,166 of 1957 (827,016). SHERRITT GORDON MINES, LTD. Method of producing metal-coated non-metallic particles.

25,932 of 1957 (826,878). G. FISCHER A.-G. Apparatus for determining the specific surface area and the grain shape of a granular substance.

10,842 of 1958 (826,337). SHERRITT GORDON MINES, LTD. Methods of producing non-ferrous metal powder from a solution or slurry.

31,123 of 1958 (826,606). SMITH ENGINEERING WORKS. Gyratory crusher concave adjustment.

Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE. † Article digested in the MAGAZINE.

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Amortization, Industrial : *Curves, Study.* Les Fonctions "Canoniques" d'Amortissement. M. BERNARD, *Ann. Mines,* Jan., 1960.

Metals, Minerals : *Outlook, 1960.* Annual Survey and Outlook. *Engg. Min. J.,* Feb., 1960.

†**Mining, Australia :** *Production, 1959.* The Mineral Industry in Australia. Australian Mineral Industry *Quarterly Review,* Dec., 1959.

***Mining, Tanganyika :** *Results, 1959.* Tanganyika Mining Industry, 1959. THE MINING MAGAZINE, Mar., 1960.

Production, Africa : *Mineral, Belgian Congo.* Belgian Congo—Part II. *Min. World* (San Francisco), Feb., 1960.

Production, Australia : *Uranium, Queensland.* The Mary Kathleen Uranium Project. A. NELSON, *Mine, Quarry Engg.,* Feb., Mar., 1960.

Production, Canada : *Iron, Review.* Iron Mining in Canada. *Precambrian,* Dec., 1959.

Production, Canada : *Mineral, Ontario.* Mining Operations in 1957. D. J. FIELD, *Ont. Dept. Mines Ann. Rep.,* Vol. LXVII, Part 2, 1958.

Resources, Algeria : *Iron, Tindouf.* The Iron Ore Deposit at Tindouf (Gara-Djebilet). *Ann. Mines,* Jan., 1960.

Resources, Canada : *Iron, Western.* Iron Deposits of Western Canada. C. P. GRAVENOR, *Western Miner,* Jan., 1960.

Resources, United States : *Iron, Survey.* Iron-Ore Resources of the United States, Including Alaska and Puerto Rico, 1955. M. S. CARR, C. E. DULTON, *U.S. Geol. Surv. Bull.* 1082-C.

Resources, United States : *Limestone, California.* Geology of Limestone and Dolomite Deposits in the Southern Half of the Standard Quadrangle, Tuolumne County. E. W. HART, *Cal. Div. Mines Special Rep.* 58.

Geology

***Conglomerates, Auriferous :** *Origin, South Africa.* The Present State of the Witwatersrand Controversy. C. F. DAVIDSON, THE MINING MAGAZINE, Feb., Mar., 1960.

†**Economic, Canada :** *Sulphides, N.W. Ontario.* The Geology of the Geco Mine. W. L. BROWN and others, *Canad. Min. Metall. Bull.,* Jan., 1960.

Economic, Manganese : *Deposits, Oxide.* Deposits of the Manganese Oxides. D. F. HEWETT, M. FLEISCHER, *Econ. Geol.,* Jan.–Feb., 1960.

Economic, United States : *Fluorspar, Utah.* Geology of the Thomas Range Fluorspar District, Juab County, Utah. H. M. STAATZ, F. W. OSTERWALD, *U.S. Geol. Surv. Bull.* 1069.

Economic, United States : *Uranium, Colorado.* Geology of the Garo Uranium-Vanadium Copper Deposit, Park County, Colorado. V. R. WILMARTH, *U.S. Geol. Surv. Bull.* 1087-A.

Economic, Uranium : *Assessment, United States.* Uranium Resources of the Green River and Henry Mountains Districts, Utah: A Regional Synthesis. H. S. JOHNSON, *U.S. Geol. Surv. Bull.* 1087-C.

Economic, Uranium : *Veins, Montana.* Primary Mineralization of Uranium-Bearing "Siliceous Reef" Veins in the Boulder Batholith, Montana. B. H. BIELER, H. D. WRIGHT, *Econ. Geol.,* Jan.–Feb., 1960.

Ores, Pyritic : *Bodies, Conformable.* General Features of the Conformable Pyritic Orebodies: Part I—Field Association. R. L. STANTON, *Canad. Min. Metall. Bull.,* Jan., 1960.

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†**Survey, Aerial :** *Uranium, Australia.* Aerial Exploration Methods of Prospecting for Uranium Mineralization in Australia. I. A. MUMME, *Queens. Gov. Min. J.,* June 20, 1959.

Survey, Geophysics : *Utah, Colorado.* Regional Geophysical Investigations of the Lisbon Valley Area, Utah, and Colorado. P. E. BYERLEY, H. R. SOESTING, *U.S. Geol. Surv. Prof. Paper* 316-C.

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Smelting, Copper : *Performance, Furnace.* Factors Affecting Copper Reverberatory Furnace Performances and Their Influence on the Choice of Smelting Method. L. R. VERNEY, *Bull. Instn. Min. Metall.,* Feb., 1960.

Temperatures, Kiln : *Measurement, Review.* The Measurement of Cement Kiln Shell Temperatures. R. E. BOEHLER, H. C. LUDWIG, *Min. Engg.,* Feb., 1960.

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Mucker, Shaft : *Use, Sweden.* Aligrab—New Shaft Mucking Method from Sweden. T. BJORNBERG, B. KARLSSON, *Min. World* (San Francisco), Feb., 1960.

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Tyres, Maintenance : *Equipment, Heavy.* Reconditioning Tyres for Earthmoving Equipment. W. E. DUNKLEY, *Mine, Quarry Engg.*, Mar., 1960.

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Breaking, Blasting : *Holes, Diamond-Drill.* 4⅜-in. Diamond Drill Holes Applied to Underground Blasting. J. A. PATTERSON, *Canad. Min. J.*, Jan., 1960.

Breaking, Coal : *Air, Compressed.* Experience in Compressed-Air Blasting. *N.C.B. Prod. Dept. Inform. Bull.* 60/215.

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Handling, Shaft : *Design, Station.* Standardization of Shaft Bottom and Shaft Top Minecar Circuits. F. H. LEE, *Coll. Engg.*, Feb., Mar., 1960.

†**Hazard, Explosion :** *Ignition, Gas.* Frictional Ignition of Gas During a Roof Fall. J. NAGY, E. M. KAWENSKI, *Rep. Inv. U.S. Bur. Min.* 5548.

Hazard, Fire : *Conveyors, Belt.* Fire Prevention Device for Underground Conveyors. M. A. KILBURN, *Coll. Engg.*, Mar., 1960.

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Sinking, Shaft : *Speed, Improvement.* Improving Shaft-Sinking Speeds. F. C. SWALLOW, *Coll. Engg.*, Mar., 1960.

Support, Ground : *Loading, Coal.* Experience with Power-Loading and Self-Advancing Supports in a Northumberland Colliery. J. T. HARDING, R. R. G. P. JACKSON, *Trans. Instn. Min. Eng.*, Mar., 1960.

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Water, Usage : *Law, Review.* Water Laws Related to Mining. W. A. HUTCHINS, *Min. Engg.*, Feb., 1960.

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Comminution, Grinding : *Input, Energy.* Energy Input and Size Distribution in Comminution. R. SCHUMANN, *Min. Engg.*, Feb., 1960.

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***Exhibition, London :** *Exhibits, Survey.* Mineral Processing Exhibition. THE MINING MAGAZINE, Mar., 1960.

General, Australia : *Uranium, Queensland.* The Mary Kathleen Uranium Project: 2, Milling. A. NELSON, *Mine, Quarry Engg.*, Mar., 1960.

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Handling, Sands : *Transport, Hydraulic.* The Hydraulic Transportation of Sands. C. I. ROBERTS, *Proc. Aust. Inst. Min. Metall.*, Dec., 1959.

Preparation, Coal : *Practice, France.* General Trends in Coal Dressing and French Contributions to Techniques in the Field. M. H. FOURNOL, *Ann. Mines*, Feb., 1960.

†**Tailings, Disposal :** *Design, Dam.* Points on Dam Design. E. V. GIVEN, *Min. Engg.*, July, 1959.

Shown here is the T2GH (High Tipping Model) designed for dumping into conveyors. Another version is available for tipping into shafts.

Atlas Copco Auto-Loader raises output, lowers costs in German coal mine

150% increase in drifting capacity

Germany's chief mineral asset is coal. In fact the rich German coal fields are among the most important in Europe. One of the leading mines west of the Rhine is Pattberg, which in 1958 produced almost 2 million metric tons of consumable coal. Despite the use of up-to-date methods and some of the most modern mining equipment available, Pattberg is faced with two of the current problems confronting the industry:—

- The urgent need to cut production costs to a minimum — due to the increasing competition for markets.
- The growing necessity to eliminate heavy physical labour — reflecting the rising living standards of mine-workers.

Engineers at Pattberg have found that mechanised loading is helping them to solve both problems. The original drifting capacity was 0.44 metres per man-shift. Now, by progressive improvements in loading technique, this has been raised to 1.16 metres — an increase of more than 150%. Their superiority to any similar machines having been proved by stringent tests, Atlas Copco T2GH Auto-Loaders are now in extensive use in the Pattberg mine.

A two-man team carries out the complete drifting operation — drilling, blasting, loading and timbering. While one miner is loading, the other prepares for timbering. The figures in the table refer to drifting in a cross-cut with an area of about 10m² where the average advance is about 2.5 metres a round. Statistics show the average time schedule for a team on an eight hour shift to be:—

		% *of effective working time (excluding breaks)*
drilling	95.5 minutes	26.7
charging and stemming	51 ,,	14.4
loading and sundry work	100.5 ,,	28.3
timbering	109 ,,	30.6
	356 minutes	100%

The Auto-Loader tips onto an armoured conveyor which is extended once a week. Haulage distance, thus, varies between 10 and 30 metres. Perhaps the T2GH could help improve capacity at your mine?

Contact your local Atlas Copco company or agent or write to one of the addresses below:

Atlas Copco PUTS COMPRESSED AIR TO WORK FOR THE WORLD

Atlas Copco AB, Stockholm 1, Sweden. Atlas Copco (Great Britain) Ltd., Maylands Ave., Hemel Hempstead, Herts

DL14

When you see a hole

think of

Sandvik Coromant

SANDVIK COROMANT is today's most widely used tungsten carbide tipped equipment for rock drilling. All over the world you will find Sandvik Coromant Drill Steels, Extension Steels and Detachable Bits.

ATLAS COPCO, world's largest company specialising solely in compressed air equipment, is the sales organisation in 90 countries of Sandvik Coromant products for rock drilling. For details contact your local Atlas Copco Company or Agent, or write to Atlas Copco AB, Stockholm 1, Sweden.

SANDVIK *Coromant* SOLD THROUGHOUT THE WORLD BY *Atlas Copco*

COMPANY MEETINGS AND REPORTS SECTION

RAND SELECTION CORPORATION LIMITED

(Incorporated in the Union of South Africa)

Higher Profits and Dividend

Increase in Market Value of Investments

The following are extracts from the review by the chairman, Mr. A. Wilson, which has been circulated with the annual report and accounts :—

Interest in investment in South Africa has been maintained during the year and trading in South African shares on the Johannesburg and London Stock Exchanges has remained active. The improvement in the level of prices of quoted shares in which your corporation is interested, including its holding in its subsidiary, South African Townships, Mining and Finance Corporation Limited, has resulted in the very satisfactory increase of £8,026,602 in the market value of the corporation's investments, an increase of 49% over the market value at the end of the previous year. At the same time the increase in the book value of quoted investments held by the corporation amounted to only £188,471.

The net profit after taxation amounted to £1,559,335, which is £226,984 more than for the previous year. This improvement is almost entirely attributable to the substantial increase in the income received from our subsidiary and the net profit made on the realization of investments. The board therefore felt justified in declaring a higher final dividend of 1s. 9d. per share, making a total distribution of 2s. 9d. per share for the year, compared with 2s. 6d. for the year ended September 30, 1958. The board also transferred £250,000 to the general reserve, which now stands at £7,000,000.

The corporation continues to participate in prospecting activities of the Anglo American Corporation Group in Central and Southern Africa and expenditure of £174,861 incurred in this connexion during the year has been written off in the appropriation account.

The corporation's 4½% ten-year unsecured loan stock is due for redemption on September 30, 1960, and your directors are at present considering means of financing the repayment of this loan stock.

Principal Interests

Your corporation's main interests are held directly or indirectly in primary products, copper, diamonds, gold, and uranium, and to a less extent in industrial companies. It was mentioned last year that the liquid position of the corporation had improved substantially, but in view of the corporation's right to participate with Anglo American Corporation of South Africa, in new business, it cannot be considered entirely satisfactory.

Nevertheless, it has been possible to interest ourselves in new companies—which is so important if we are to maintain our position as a leading financial company—and to write down the book value of certain investments. At the year-end current assets exceeded current liabilities and provision for taxation by £499,342.

We have taken interests in certain companies through our association with the Anglo American Corporation of South Africa, Limited, and I would like to mention particularly our participation in United Dominions Corporation (S.A.) Limited, a company formed to finance hire purchase and long-term credit for the motor, engineering, and allied trades. We have also obtained an interest in Western Areas Gold Mining Company Limited.

Through the year we increased our holding in South African Townships, Mining and Finance Corporation Limited to 4,460,091 shares. That corporation's net profit for the year ended September 30, 1959, rose by £95,709 to £462,744 mainly as a result of the increased income received from its investments in the Orange Free State gold field and it was able to pay a dividend of 1s. 6d. per share, compared with 1s. for the previous year.

The profits of West Rand Investment Trust Limited showed a substantial rise of £921,263 for the year 1958 and the company declared a total dividend of 3s. 6d. per share, compared with 3s. for the previous year. Increased production and profits have been made by the Vaal Reefs, Buffelsfontein, and Hartebeestfontein gold mining companies during 1959. Zandpan Gold Mining Company, Limited began full-scale shaft sinking this year.

While the scope of profitable mining activity in the older East Rand mines is diminishing, as is evidenced by the recent commencement of repayments of capital by Brakpan and Springs mines, this is in some measure being off-set by the extension of mining operations into new areas.

In January, 1959, Winkelhaak Mines Limited, the first new mine in the Kinross area, declared its maiden working profit. Later on in the year two new companies, Leslie Gold Mines Limited and Bracken Mines Limited, were formed to mine the area to the west of Winkelhaak and your corporation has acquired interests in both these mines.

Your company also intends following up its investment in The South African Land and Exploration Company Limited by subscribing for its proportion of the £2,000,000 of 6% unsecured registered notes recently offered to shareholders of that company and Anglo American Corporation of South Africa, Limited. The proceeds of the note issue are to be used towards the financing of a new shaft system which is being sunk to facilitate opening up and further exploration of the Withok area.

Diamonds and Copper

The corporation retains a considerable interest in the diamond industry through its holding in Anglo American Investment Trust Limited. A year ago it was predicted that 1959 would be a good year for the De Beers Group and the successes of this last year have surpassed expectations. Gem sales reached £63,033,187 and industrial sales £28,102,756, making a total of £91,135,943 which far exceeds previous records.

The copper mines of the Anglo American Corporation Group have had a successful year. Rhodesian Anglo American Limited increased its net profits by

more than £1,000,000 and paid a dividend of 5s. per share, which is 1s. more than for the previous year.

Bancroft Mines Limited resumed operations at the beginning of April, 1959, and production at that mine is being steadily increased to the present target of 50,000 long tons of copper per year. Profits are satisfactory and, provided the copper price is maintained at a satisfactory level, payment of a maiden dividend may be possible in the not too distant future.

Our investment in the Rhodesian copper industry should show increasing returns over the next few years, provided the political progress of the Federation continues unimpeded.

We have had a satisfactory year and we look forward to the future with confidence.

THE CONSOLIDATED MINES SELECTION COMPANY LIMITED

OUTSTANDING YEAR FOR SOUTH AFRICAN GOLD MINES

The following is an extract from the statement by the chairman, Mr. A. Comar Wilson, which has been circulated with the annual report for 1959 :—

The year under review has been a satisfactory one, the profit after taxation being higher by about £34,000. I would remind you that last year we received an amount of £126,000 in Double Taxation Relief in respect of previous years, which was, of course, a non-recurring item and must be ignored in making a comparison between the full results of 1958 and 1959.

The year was an outstanding one for South African gold mining. Monthly output figures reached their highest level, with the newer producers in the Free State and Far West Rand more than compensating for gradual loss of gold production from the older mines of the Rand.

Continued Interest in South African Shares

Last year American buying was again an influence in the Union gold share market. Coupled with excellent results from some of the newer mines this led to firmness in prices, especially for the shares of the new producers and their associated finance houses.

At the same time industrial shares in the United Kingdom had a substantial rise and this gave considerable impetus to the Unit Trust Movement. The majority of Unit Trusts in this country include one or more of the South African mining houses or Rhodesian copper mining houses in their portfolios, which heightens the demand for these shares. The quest by Unit Trusts for mining market leaders to invest in, especially those with a higher than average yield, is now tending to focus attention on the established Union gold producers, particularly the newer mines.

However, there was during 1959 a marked trend towards the repatriation of South African stocks. On balance, during the first nine months of the year, £14,000,000 of South African shares and securities previously held outside the Union were bought by South African residents. This phenomenon certainly indicates confidence in the future on the part of those resident in the country. Outside South Africa the industrial market in the United Kingdom and in many European countries has offered such great opportunities that it is not surprising that European holders of South African shares have been tempted to switch back into their own industrial stocks. The fact that, notwithstanding this, South African shares have been a buoyant market is most encouraging and an indication of the underlying strength of the Union's economy.

A Notable Year for Diamonds

Last year was a notable one for diamonds. World sales at £91,000,000 were £26,000,000 up on 1958 and £15,000,000 above the previous record established in 1957.

Copper prices were higher than for 1958, ranging from a low point at about £210 a ton to a high of £267 per ton. The average cash price for the metal on the London Metal Exchange for the year was £238 or some £40 per ton above the previous year and Rhodesian producers benefited accordingly.

Some indication of the favourable effect on gold, diamond, and copper share prices of some of the factors I have mentioned may be gained from the increase in the market value of our own investments over the year. The aggregate figure of quoted investments was £6,200,000 at December 31, 1959, compared with £4,800,000 at the beginning of the year. We had, however, about £300,000 more invested, taken at the usual balance sheet valuation.

We have acquired interests in McIntyre Porcupine and Locana Minerals. These are both Canadian companies. McIntyre Porcupine is well known as a mining company with high-class management and a diversified portfolio of investments. Locana Minerals is a newly-formed mining investment company which will, we hope, provide us with opportunities to participate in new mining ventures in Canada.

We are proposing to keep the cash dividend at the same rate as for 1958. Shareholders received free in March, 1959, one new share for every ten held and as these shares ranked for both the interim and final dividends for 1959 we are in effect paying out 10% more.

As your company has had another good year, we are also proposing to repeat last year's capitalization issue, again in the ratio of one fully-paid new share for every 10 shares at present held. This will be the fourth capitalization issue we have made in the last six years but each one has to be regarded as exceptional and not necessarily to be repeated.

Investment income has risen by well over £100,000 since 1953, when we first began to benefit from dividends from the new gold mines and we expect the present level to be at least maintained for the current year. In the absence of unforeseen difficulties we should, therefore, be able to pay the present rate of cash dividend for 1960 on the capital as enlarged by the proposed bonus issue.

THE BRITISH SOUTH AFRICA COMPANY

(Incorporated by Royal Charter)

Capital and Reserves Exceed £45½m.

Lord Robins on Record of Progress and Enterprise

The 62nd annual meeting of The British South Africa Company will be held on March 17 in London.

The following is an extract from the circulated statement of the President, Colonel The Lord Robins, K.B.E., D.S.O. :—

During the year, an Agreement was concluded between this company, one of its subsidiaries (Cecil Holdings Limited), and Union Corporation Limited which gave Cecil Holdings a substantial interest in Union Corporation's enterprises and involved the issue to a subsidiary of the latter of 455,000 stock units of The British South Africa Company.

I am glad to say that owing to the satisfactory levels at which the prices of base metals have been maintained during the past year—and particularly the price of copper—our mineral revenue from Northern Rhodesia reached a figure of £9,395,827, after allowing for the Northern Rhodesian Government's 20% share, but before the deduction of income tax in the Federation.

Our investment income shows a small decrease when compared with the previous year by reason of the fact that the dividends which we received from the Northern Rhodesian copper mines were related to a period when the price of the metal was considerably less than it had been for many years. Our estates profits have suffered from adverse weather conditions and reductions in the prices obtainable for certain of our products. Both of these sources of income should show an increase in 1960.

The consolidated net profit of the Group before taxation at £11,439,026 shows an increase over the previous year of £3,467,829. The amount of £4,854,888 charged in the profit and loss account for taxation would have been higher but for our qualification as an Overseas Trade Corporation and the net profit after taxation stands at the satisfatory figure of £6,584,138 against £4,363,217 in the previous year.

An interim dividend of 1s. 6d. was paid on October 9, 1959, which together with the final dividend now recommended of 4s. 6d., will make a total of 6s. per stock unit or share.

The capital and reserves of the group now stand at £45,590,660 an increase of £4,909,683 over the previous year.

On the assets side of the balance sheet there has been a small increase in the amount of fixed assets. Current assets exceed liabilities by £2,997,083 against which the Group had outstanding commitments of approximately £2,360,000.

The overall book value of the Group's investments has, during the course of the year, increased by about £4½ millions, of which quoted investments account for some £2 millions and unquoted investments for approximately £2½ millions.

Mining

The Federation, and in particular Northern Rhodesia, must always have first priority as a field of investment and in addition to its interest in the copper mines the Group has made substantial contributions to the financing of the prospecting companies which are searching for further mineral deposits.

Such operations on a large scale were continued throughout the year, primarily by companies controlled by the large mining Groups operating in the Territory. Moreover I am glad to report that we recently satisfactorily concluded negotiations with the prospecting companies controlled by the Rhodesian Selection Trust Group of companies whereby their prospecting rights have been extedend to December 31, 1971, with certain rights thereafter.

Furthermore, Chartered Exploration Limited, a prospecting company in which the Group has a large interest, continued to expand its organization and activities and has just about reached its optimum. This company is also conducting prospecting operations for Kasempa Minerals Limited in the area known as the "Kasempa Salient," which became possible after The British South Africa Company had obtained the consent of the Government of the Barotseland Protectorate. It is to be hoped that in due course of time permission will be granted to prospect in Barotseland proper. In the meantime we are exploring the possibilities of arranging for prospecting to be undertaken in that part of the Balovale District west of the Zambesi River which was formerly part of Barotseland.

No new discoveries of any great value have been made recently, but, if anything should be found in the future, the Group will be in a good position to take an active part in financing such ventures, from which it would receive royalties up to and including the year ending September 30, 1986, and in which it would have a continuing interest as shareholders during the life of any such new mines.

Although I can report no spectacular discovery this year, it is gratifying to note that full-scale production was resumed at the Bancroft mine in the early months of 1959 and this materially contributed in raising the total copper production in Northern Rhodesia during the year under review to the record figure of over 475,000 tons.

Commenting on the company's three score years and ten of progress and enterprise, Lord Robins said : The advance in the numbers, as well as in the conditions of the African peoples in the two Rhodesias, and the growth of industry and wealth which are opening up great opportunites for both Europeans and Africans, could not have been brought about but for the work done by the company. He added : Constitutionally, this year will be of great importance to the Federation. The Commission under Lord Monckton's chairmanship will examine and take evidence as to the operation of Federation within the present Constitution and there can be little doubt that the findings of the Commission will be of considerable value when the four Central African Governments meet the United Kingdom Government later this year to review the Federal Constitution and to decide whether, in the light of 6½ years' experience of Federation, any changes are required in the functions and powers of the Governments concerned.

GHANA MAIN REEF, LTD.

Mr. C. J. Burns's Statement

The twenty-sixth annual general meeting of Ghana Main Reef, Ltd., was held on March 7, at The Chartered Insurance Institute, London, E.C. Mr. C. J. Burns, chairman, presiding.

The following is an extract from his circulated statement for the year eneded June 30, 1959 :—

The confidence expressed in my last review has been justified by the year's results. No further dividend for the year under review can be recommended, since an interim dividend of 7½% and a bonus of 2½% have already been distributed. For the current year your board have declared an interim dividend of 7½%, less income tax, payable on March 11, 1960.

Two main factors highlight the operations for the year, The installation of a single-drum hoist, capable of hoisting waste rock through the sinking compartment in Tuappim Internal Shaft from No. 20 level to No. 8 Level, was nearly completed, and should be in operation very shortly. The persistent pattern of the main ore shoots has convinced your Board that an exploration programme to depth to prospect the fissured areas between and beyond the known ore shoots is absolutely necessary. Already promising values are being found, giving great encouragement for the future of this phase of development. We have every hope that the mine grade will be increased once the developments at depth have reached a stage which will allow the hoisting of the richer grade ore from the deep levels of the Tuappim section.

Chairman's Additional Remarks

In the course of his speech to stockholders, the chairman said that in the Tuappim section the summary of the payable development exposed to date during the current financial year amounted to 520 ft. averaging 9·4 dwt. over 57·3 in. on Nos. 17, 18 and 19 levels. This is most encouraging and would prove not only a satisfactory addition to ore reserves but a sound indication that the reef was persisting to depth. Before the end of the year, it was confidently expected to expose part of the 20 level. In the Main Shaft section the summary of payable development for the same period amounts to 165 ft. averaging 11·1 dwt. over 43·9 in. on Nos. 13, 18 and 21 levels. The No. 18 level drive north and No. 19 drive north and south would be fully exposed before the end of the financial year.

The chairman reiterated his confidence in the future of Ghana and dwelt upon the need for immediate development of opportunities for suitably trained Ghanaians to enter the mining industry.

Mr. C. W. Tachie-Menson, C.B.E., an eminent Ghanaian, had accepted a seat on the board and it was hoped he would join them in a few months.

The report was adopted.

FALCON MINES, LTD.

Mr. F. L. Wigley's Statement

The fiftieth annual general meeting of Falcon Mines, Ltd., will be held on March 31 in Bulawayo.

The following is an extract from the statement of the chairman, Mr. F. L. Wigley, circulated with the report and accounts for the year ended September 30, 1959.

The reasons which prompted your board's decision to increase the issued capital by a further 181,561 shares of 5s. each are fully stated in the circular to members dated February 4, 1960, and I need only add that it will be an advantage to have funds available for accelerating an exploratory development programme as initial results may justify.

The net profit for the year was £151,236. The sum of £75,929 has been appropriated for expenditure on fixed assets and mine stores. After providing for dividends Nos. 11 and 12 totalling 10½d. per share (17½%) which absorbed £79,433 and bringing to account an over-provision for taxation in previous years of £971, there remained a balance unappropriated of £9,446 compared with £12,601 brought forward from last year.

At the Dalny Mine I am pleased to report that the fresh series of metallurgical tests referred to in my review last year resulted in a most satisfactory improvement in gold extraction. Total residues for the year averaged 0·72 dwt. per ton but the average for the last six months of the year was only 0·59 dwt. and there has been a further reduction during the current year.

Working costs were reduced by 6d. per ton milled compared with the previous year in spite of a substantial increase in development expenditure. The proposal to raise the electricity tariff by 15% was successfully opposed by the Southern Rhodesia Mining Industry and a revision to an increase of 5%, pending a further investigation into the whole tariff structure, was obtained. The higher charges came into effect in February, 1960.

The estimated ore reserve at September 30, 1959, was 672,000 tons valued at 4·90 dwt. per ton over a width of 107 in.

On the Pixy section a shaft was sunk to a depth of 380 ft. and a level (No. 4) was established. A cross-cut from the shaft intersected the reef in the vicinity of the No. 2 bore-hole mentioned in last year's review and driving had exposed 105 ft. of payable reef by the end of the year. Since the close of the year work on this level has continued to yield encouraging results and, in addition, the drive of the Pixy reef commenced from the Dalny 7 level cross-cut has intersected values at this lower horizon in the shaft area. Work is now in hand to effect a holing between this level and 5 level to which the Pixy shaft was sunk during January and February, 1960.

At the western end of the strike the dewatering and reclamation of old shafts in the Arlandzer area has reached the stage where development in fresh rock below the oxide zone worked in former years can commence.

The Tribute Agreement over the M'tuga Copper Claims was extended to August 31, 1960. Royalties totalling £13,276 were received from the tributors during the year.

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JANTAR NIGERIA CO., LTD.

The forty-seventh annual general meeting of the Jantar Nigeria Co., Ltd., was held on February 16 at Winchester House, London, E.C.

Mr. C. A. P. Tarbutt, chairman and managing director, presided.

The chairman said :—

Output.—The production of tin was restricted throughout the year under the International Tin Agreement and the output amounted to 147·54 tons against 237 tons last year when restriction only operated for approximately nine months of the year.

Columbite production was 232 tons as compared with 194·5 tons last year.

Columbite.—The demand for columbite, particularly for the grade of ore which your company produces, has increased during the year and slowly rising prices for the year's output have been obtained.

Contracts have been entered into for the whole of the output for the year 1959–60 at prices to be negotiated quarterly.

On the assumption that the future demand for columbite will at least be maintained and may increase it has been decided to start working our primary deposit on an experimental basis.

Meanwhile check drilling has been carried out in order that the primary ore reserves may be assessed. When the results are available stockholders will be informed.

Basalt Lead.—No work has been done on the basalt lead during the year. It must be borne in mind that there are some 2,000 tons of tin indicated still to be won from the basalt lead in addition to the amount shown in the manager's report.

When tin restriction ends another attempt must be made to work this deposit economically at a high production rate, which is clearly impossible so long as tin restriction remains in force.

Ore Reserves.—For some time past your directors have considered that the ore reserves as shown annually in the directors' and manager's reports have not been on a sufficiently accurate basis.

During the year considerable work has been done by the manager in order to establish up-to-date ore reserve figures. As a result it is believed that the figures of reserves shown in the directors' and manager's reports are more accurate than those given in the past.

The ore reserves as recalculated are :—

Tin . .	1,404 tons
Columbite .	1,796 tons

as compared with the figures shown in last year's directors' report of :—

Tin . .	1,176 tons
Columbite .	1,052 tons

General.—Your directors consider that it is necessary to continue to conserve the cash resources of the company having regard to the fact that some capital expenditure will be involved in opening up production from the primary columbite and that in the future further capital expenditure must be incurred when the deep lead is re-opened.

Net profit for the year ended September 30, 1959, after taxation amounts to £21,681. Adding to this the amount brought forward from last year of £15,383, and an amount of £4,500 written back, being provision for taxation no longer required, the distributable balance standing at the credit of the profit and loss account is £41,564.

Your directors recommend the payment of a dividend of 4½d. per share (15%), less income tax at 7s. 9d. in the £, which will absorb £20,672, leaving the sum of £20,892 to be carried forward.

Mr. Jonathan Janson has been appointed to the board to fill the vacancy caused by the death of Mr. A. C. Tarbutt and you will be asked to confirm this appointment in due course.

I am sure that you would wish me on your behalf to thank the manager and his staff, both European and African, for what they have achieved during the past year. I think we are very fortunate to have such an excellent team.

The report and accounts were adopted.

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RAMBUTAN, LTD.

Major W. E. Hosking's Statement.

The fifty-fourth annual general meeting of Rambutan, Limited, was held on February 24 at the Registered Office, Station Hill, Redruth.

Major W. E. Hosking (chairman) presided.

The reports and accounts for the year ended June 30, 1959, having been circulated for the prescribed time, were taken as read, as was also the chairman's statement, circulated with the report and accounts, from which the following is an extract :—

It is with deep regret that I have to refer to the loss this company has suffered by the death on January 20, 1959, of Mr. D. W. Thomas, who had been a director and chairman of the company for many years as well as legal adviser to the board.

To fill the vacancies on the board Mr. J. T. Chappel, C.B.E., M.I.M.M., and Mr. N. D. Thomas were appointed directors of the company.

The accounts for the financial year ended June 30, 1959, show a loss of £10,250 after the payment of royalty to the Malayan Government of £8,253 in respect of tin-ore sold during the year and provision of £795 for United Kingdom Tax on interest received.

The sum of £2,580, provision for taxation now no longer required, has been credited together with an Eastern receipt of £29 from a previous year. Capital expenditure of £5,292 incurred during the year has been written off by transfer from general reserve, leaving a balance standing to the credit of the profit and loss account of £11,061.

The company continues to be treated for taxation purposes as an Overseas Trade Corporation, but this benefit is partially off-set by the increase in Malayan Income Tax from 30% to 40%.

Production

A comparison of mining results for the year under review with those of the previous financial year is difficult, as in the year ended June 30, 1958, restriction on ore sales was in force for 6½ months only, while in the year ended June 30, 1959, restriction in varying degrees was operative throughout, permissible ore sales being limited to between 42·9% and 48·5% of the company's assessment, based on production during the years 1953–57. In consequence a loss of £7,907 was sustained in mining operations and no dividend could be declared.

The output from the mine was 99 tons of tin-ore, of which 95·88 tons were permitted to be sold under Tin Control Regulations, from the treatment of 247,500 cu. yd. of ground with a recovery of 0·89 lb. per cu. yd. Included in the yardage treated was ground containing lower values arising from development work. The price received for tin-ore sold was £467 per ton.

The attention of members is drawn to the report of the general managers, Messrs. Osborne and Chappel, circulated with the reports and accounts, which gives particulars of the work done at the mine.

As previously advised in the current financial year ore sales as authorized under Tin Control Regulations during the quota periods July 1 to December 31, 1959, were 65 tons.

Contributions to the Buffer Stock, compulsorily levied under the International Tin Agreement, amounted to £4,024, thereby increasing the total contributions made by this company to £13,580. During the current year further contributions, to August 27, 1959, when the compulsory levy terminated, have increased this total to approximately £14,800. This sum represents an appreciable proportion of the company's assets, virtually frozen until such time as the Buffer Stock may be wholly or partly liquidated.

For the Quota Period January–March, 1960, the total exportable amount has been further increased by 6,000 tons to 36,000 tons, thereby increasing the permissible ore sales for the period of European Tin Producers in Malaya to 70·87% of their individual assessments. Provided this improvement is maintained and the metal price continues at its present level, much better results can confidently be anticipated from the company's mining activities.

The statement of accounts and balance sheet, together with the directors' report, were received and adopted.

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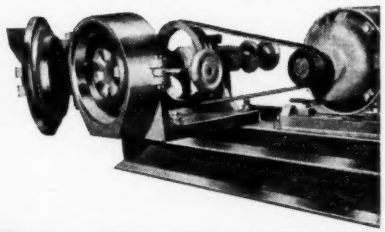

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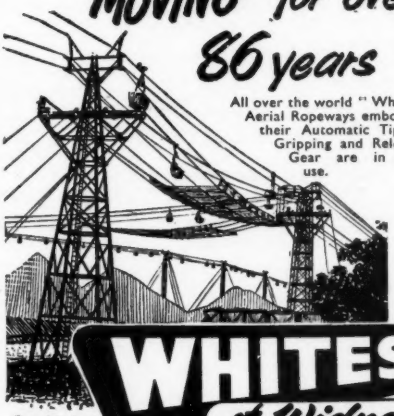

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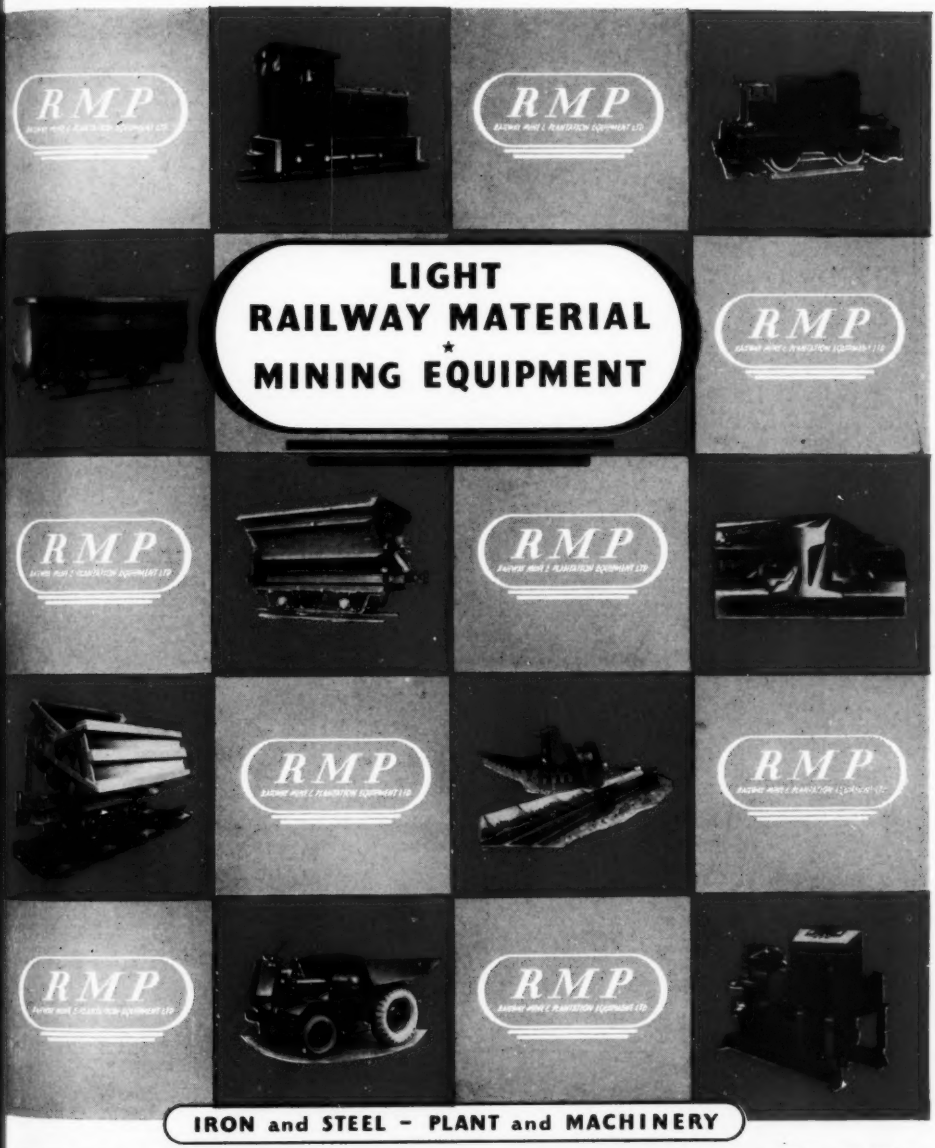

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